THE

ELECTRICAL REVIEW.

VOL. XLII. JANUARY 21, 1898. No. 1,052.

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THE

UNIVERSAL ELECTRICAL DIRECTORY

(J. A. BERLY'S).

ALTERATIONS, ADDITIONS AND ADVERTISEMENTS

For 1898 Edition

SHOULD BE SENT PROMPTLY TO

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4, LUDGATE HILL, LONDON, E.C.

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CHEAP PRODUCTION.

IF we assume that the engineers' strike is now practically over, the best thing to be done is to push forward their rapid and well-paid re-employment as quickly as possible. Six months of idleness is in itself demoralising, and the men have gone through quite sufficient hardships, on the whole, fairly peacefully, to forbid any desire to extend further the sharp lesson of defeat. Now is the time, when they are thoroughly beaten, for the employers to step forward and drive home the arguments of the past half-year by deeds. They have the power in their hands to insist on better and more honest service. It is their duty to do it, and to do it so thoroughly that the men will assist to get back some of our lost trade. If this be done, there is good reason to suppose the country will be almost over-crowded with work. This will mean good wages, and, if this time of better wages arrives quickly, the men will learn, before they have become powerful enough to again indulge in skulking, that the system of work pays them better than the system of idling. As soon as they learn this lesson, the occupation of the agitator, who has lived on the doctrine of restriction and harassment, will have gone. Coming out as victors from the struggle, the employers have the right to insist on work being done for money paid, but they are equally bound to see to their own duties. Improved machinery and shop methods and an abandonment of all *laissez faire* notions must be faced. It is important that no loophole be left for the arrows of trades union criticism. Trades unionism is chameleon-like in its colours, and changes rapidly in its methods of attack. Unable to compel employers to its final outrageous demands for the maximum of wages for a minimum of work, it is by no means unlikely that future attempts at interference will be in the very direction the employers have practically been inviting it. Realising that the game of restriction is up, and perhaps having absorbed some of the scathing criticisms which have been levelled against unionism, as it has become, the leaders of reconstituted unionism may profess a willingness to increase output. They may make demands for men to attend several machines, and may lodge complaints as to the non-efficiency of old plant, and in various ways assume a virtue they do not feel, or have only lately acquired. Should events prove that the employers really have obtained the mastery, a very serious responsibility will be with them. In their hands lies the future of English trade. Their own weak concessions to the galling tyranny of trades unionism have done already much irreparable damage. True, the first offender has been unionism, and the employers perhaps did not foresee the result of their concessions; but *facile descensus averni*, and in this case the bottom has fortunately been reached the more quickly at the hands of Mr. Barnes than in milder hands. Great ends are sometimes accomplished by unworthy and unintentional means, and, it may be, Mr. Barnes has wrought better than he knew, for it is through him the end has come. Assuming, then, that further opposition to

improved tools will now cease, English engineering firms are likely to require many new tools. For a time the Americans and their German copyists will profit, but English tool-makers, also released from bondage, should be prepared to meet the demand. Manufacturing engineering cannot be carried on with a general engineer's tools. It demands special tools and sub-division of operations.

It seems to be an axiom of repetition work that the greater the number of hands through which a piece is passed, the cheaper will be its production cost, for each hand performs a distinct operation, and does it quickly as the result of practice. What is known as the American method is but this. We question if, when Mr. Burns called for American methods, he really knew just what it was he was demanding. The so-called American methods are simply the methods of many of our free English shops. We know several such, and we have recently compared the prices and discounts of one such shop with the best German shop doing similar work. The German prices are 50 per cent. higher. This shows what can be done in England, where men and masters work together. Could he but see it, the present is Mr. Barnes's great opportunity. He is an adept at shunting issues. He may now turn about face, and claim to have started the present quarrel as a last resource to compel employers to advance, all other methods failing. His friend Burns has given him the cue. It will be easy to follow it, especially as it would afford an opportunity of worrying employers to buy new tools, and the employers will have to do so, and many of them are only waiting to do so until they can be assured of the power to work them up to their limits. Nor could employers complain at such new attitude on the part of unionism. We believe it is found in America, as well as in free English shops, that men push for the latest new appliances. Pushing tools up to their maximum production wears them out more quickly, but labour is a far bigger item than tools, and the time spent in taking care of a tool by easy work would pay for a new and improved tool very quickly.

It would just suit the executive of the A.S.E. to pose as the upholders of improved methods, and to claim for their past conduct a hidden spring of action in a desperate resolve to compel employers to bring themselves into line with new methods. This would be a repetition of the dishing of the Whigs which stirred political circles some years back. There is no such militant saint as a converted sinner, and trades unionism in a new guise of pushfulness would, indeed, be a refreshing and wholesome sight, and might, indeed, constitute a form of interference that would be not unwelcome. Certain American experience with English workmen, who were free to do as they wished in the way of pushing work, showed us some time ago that a certain manufactory, with English skilled men, could beat out of the field the other works in the same trade. There is value in skill and long practice, and in manufacturing engineering there is work which the labourer and the apprentice can do well enough on automatic machinery, but there is a field beyond their scope which will always require skill and superior intelligence. There are so many articles now imported from abroad simply because of the half-hearted manner of working in England, that to supply these goods alone will absorb all our surplus labour before very long. In the interim we fear that the men, who must remain for some time out of work before they can be reinstated, will be exposed to great hardship. The employers have been training others to fill their places, and have now got the very class, at the possession of which Barnes so girds. But it is to him that this new batch of men is due. He has been the kind giver. He also, and in referring to him we mean, of course, the policy of which he is the willing or unwilling mouthpiece, has been the destroyer of the union tyranny, and from him will probably date the new and improved condition of the engineering trades of Great Britain. It is possible—we think probable—that the strike has been a blessing in disguise. It need not have happened but for the complete tangle into which trades unionism has landed everyone. Out of the clearance it has made it is everybody's duty to see that the new buildings shall be on the new plan. As with the great City fire, we ought not to rebuild only, but to remodel.

Photo-Electric Phenomena.

About three years ago we described a form of electrode considerably more sensitive to light than any employed by previous investigators up to that time, and gave a few details of its construction. This electrode was described by H. Luggin, who contributed a paper on it to the *Zeitschrift für Physikalische Chemie*, Vol 14, pages 385—393. The electrode consisted of a platinum plate covered with bromide of silver, and, when used, is paired with a similarly coated silver electrode in a decinormal solution of potassium bromide. The rise of potential is determined by a quadrant electrometer, and, in some experiments, exposure to diffused daylight caused an increase of potential of 0·42 volt. The experiments show that when illuminated by a weak light, the rate of rise of potential is uniform and represented by a straight line until a maximum value is reached, after which it remains constant, or may fall slightly. With a stronger light the rate of increase is more rapid, but the final value is not greater; the rate, however, is not directly proportional to the intensity of the light, but is proportionately less than for weak lights, whilst it is also lowered by previous exposure to powerful light. Continuous and intermittent lights of the same mean intensity appear to have the same effect. The sensitiveness of the plate, however, does not remain constant, but, even after long rests, very different potential increases are obtained with the same light. Since the end of 1894, when Luggin first began to make experiments with this form of electrode, he has been carrying on the investigation with a sensitive electrode similar to that which we have described, but which could be raised to any definite potential above that of the liquid, and he describes his new results in the *Zeitschrift für Physikalische Chemie*, 1897, Vol. 23, pages 577—635. The current produced, or the photo-current, was measured, and it was found that an intimate connection exists between the strength of the photo-current and the depth of the darkening of the sensitive electrode. As the potential of the electrode is increased, however, the photo-current decreases; and ultimately a potential is reached where the current becomes zero, and, by increased exposure, may pass over to a current of opposite sign. Where the action of the current is to remove the halogen, and hence cause darkening of the electrode, the current is called normal or positive, currents which act in the reverse sense being known as solarisation current, and experiments show that both kinds of current may be produced with the same electrode, according to its potential and the light intensity. The solarisation current, in the case of silver chloride electrodes, more readily occurs with yellow light, whilst, on the other hand, blue light favours the production of the normal current, which, in contradistinction to the solarisation current, is coterminous with the exposure. The potential at which no normal current is produced is known as the equilibrium potential, and a linear equation is found to hold for the relation of the photo-current to the defect from the equilibrium potential, and in the equation the constant is probably dependent on the dissociation of the silver salt. Luggin endeavours to connect these results with the purely photographic phenomena, and considers that solarisation appearances are intimately and casually connected with the solarisation current, and, at any rate, with printing out papers the connection between the photo-electric and photographic phenomena is in the author's opinion established. The applicability of the halogen salts appears also to be connected with the value of the equilibrium potential, and the author finally discusses at some length the production of images by development.

SOME NOTES ON SINGLE-PHASE MOTORS.

By A. C. EBORALL.

(*Continued from page* 32.)

The stationary field magnet is of the ordinary multipolar form with inwardly radiating poles, the number of these being determined by the desired motor speed and frequency of supply. It is built up of sheet iron stampings bolted together and to a cast iron frame work and bed-plate. The magnet poles have two windings; one, a thick winding of few turns, and used only at starting, the other a winding of smaller section wire and many turns, which is used when the motor is running synchronously. The armature is built up of core discs of the shape shown in fig. 3, and also has two windings. One, used at starting only, is an ordinary distributed drum winding wound in the slots, and connected to a commutator in the usual way; the other is a concentrated winding with flat rectangular coils wound in the holes, the coils being connected up in series, with the free ends connected to a pair of slip rings on the end of the shaft remote from the commutator. The number of these flat coils is equal to the number of magnet poles, and the number of slots for the starting winding is determined solely from considerations of sparking, &c. The third slip ring seen in the diagram has nothing to do with the action of the motor; inside it is a centrifugal device, which makes contact with the ring at a synchronous speed, causing a pilot lamp mounted near the motor to light up.

The starting of this motor is as follows:—A choking coil or resistance is inserted in the starting circuit, as shown, and the switch thrown over to the "start" position. The motor immediately begins to run up as an ordinary series motor, and at a synchronous speed the lamp lights up. Directly this happens the switch is put over, which puts the slip rings into direct connection with the supply mains, and the brushes on the commutator into connection with the fine wire winding of the fields, so that now the motor is running as a self-exciting reversed alternator. The number of windings on the choking coil, or the magnitude of the starting resistance, is determined by the torque required, the motor starting with any torque if enough current is given to it.

Through the courtesy of Messrs. Bergtheil & Young (London), who are the English agents for this motor, the present writer has been enabled to make some tests of its performance. These, though only of a workshop nature, came out very well indeed.

The 2½ H.P. motor provided was built for 100 volts, 133 ~, and ran at 1,500 revolutions per minute on the 100 ~ testing circuit. It started immediately without any trouble whatever at any load, and with a reasonable current consumption, this being about twice the full load current when exerting the full load torque. The efficiency above half load was high, averaging 70 per cent. The power factor of these motors for any particular load depends, to a large extent, on the field excitation, that is, on the magnitude of the resistance in series with the fields. With the resistance adjusted to give the best effect for three-quarter load, the power factor at this load came out at approximately 73 per cent., diminishing slightly as the loading was increased.

There was absolutely no sparking at the commutator either at starting or running, the carbon brushes remaining throughout in a fixed position. As a matter of fact, they are not mounted on a rocker, the holders being fixed.

This motor has, then, the following good points:—

1. It starts well on any load without any external complications, and without an excessive current consumption.
2. It stands considerable overload.
3. The power factor and efficiency are high.
4. Its speed is absolutely constant, with constant frequency.

Its defects are—

1. It is somewhat expensive.
2. It is noisy when running light or underloaded.
3. Its design is necessarily rather straggling.
4. The centrifugal service might fail to act, in which case the armature stands a chance of flying to pieces in the hands of a careless workman.
5. The "no load" current is rather high.

Owing to the absence of sparking and to the fixed brushes, the presence of the commutator is hardly felt. In the writer's opinion, the motor could be improved by diminishing the air-gap, this being somewhat excessive in the examples that have come under his notice. The superiority of these motors over others of similar design seems to lie in the fact that the armature and field windings are so adjusted that the maximum magnetic effects of each occur at the right times.

It is evident that such a motor would make a good rotary converter, continuous current being tapped off the commutator when the motor was running on alternate current mains, or *vice versa*.

II.—Alternating Magnetic Field Motors.

Owing to the fact that the direction of rotation of any ordinary direct current motor is the same irrespective of the direction of the current supplied to it, early attempts were made to adapt it for use with an alternating current by laminating the fields. But this simple modification is not enough in itself, the crude form having many serious faults, the chief of them being—

1. Low efficiency, chiefly due to the hysteresis and eddy current losses.
2. Large "no load" current, and very low power factor, due to the nature of the windings, large air-gap necessary on account of armature reaction, and to the very considerable magnetic leakage.
3. The heavy sparking, especially at starting and overloads, and which is due to the fact that as each armature coil is in turn short-circuited by a brush, it becomes the seat of very heavy induced currents, these reacting on the magnets, and causing great heating and sparking.
4. Low weight efficiency, which is caused by the impedance of the motor circuits not allowing sufficient current to get through, and principally due to the self-induction of the magnets; and in the case of shunt motors, it is found that besides this last difficulty, there are great differences of phase between field and armature currents, causing the maximum magnetic effects of each to occur at different intervals of time, this want of coincidence greatly diminishing the torque.

These inherent defects have not yet been overcome, and motors of this class are quite unsuitable for anything but the smallest work. Many attempts have been made to improve them, none of which have been successful up to the present. Thus to help bring the armature and field currents more into phase, condensers have been put in these circuits (Stanley and Kelly), or short-circuited demagnetising coils have been sunk in the pole-pieces (Stanley and Kelly). To minimise the sparking, double wound armatures have been used, so arranged that a coil is never actually short-circuited by a brush, this latter merely changing the resistance of the armature during rotation, according as one winding, or the two in parallel, came under it (Hutin and Leblanc).

The crux of the whole question is really the frequency; if this be lowered sufficiently (say to 15—20 ~), all the above defects are greatly minimised, and there is no reason why such motors should not be commercially successful.

III.—Induction Motors.

Single-phase motors of the induction type probably constitute 75 per cent. of all the single-phase motors running on the Continent at the present time, and are made by all the important firms, such as Brown, Boveri & Co., the Oerlikon Company, Kolben & Co., the A.E.G. (Berlin), and Siemens and Halske. They operate as follows:—

Let fig. 4 represent the elements of a single-phase induction motor. It consists of a stationary inducing system *or stator*, being built up of stampings with holes or slots stamped round the inner periphery, and a similarly constructed *rotor*, in the windings of which currents are induced. The stator winding consists of flat coils, wound in the holes in a manner to be more particularly described later, the number of coils depending on the number of poles required, these being given by the speed. The rotor winding is simply a number of copper bars, short-circuited at each end by means of copper rings. Now suppose the stator windings to be connected to the supply mains. An alternating multipolar magnetic field is produced round the stator, oscillating with the frequency of the supply current, and whose tendency is to produce an equal torque on the rotor in opposite directions,

and hence no rotation occurs. But if the rotor is given a start in either direction, and its speed gradually increased by some external means, a point is soon reached when the rotor will go on revolving by itself with increasing speed, until nearly synchronous rotation is attained. Load can now be put on the motor, when the speed will drop slightly, just as in the case of a polyphase motor, but to a somewhat larger extent. This "slip" of the rotor increases from a minimum at no load up to a certain point, generally about twice full

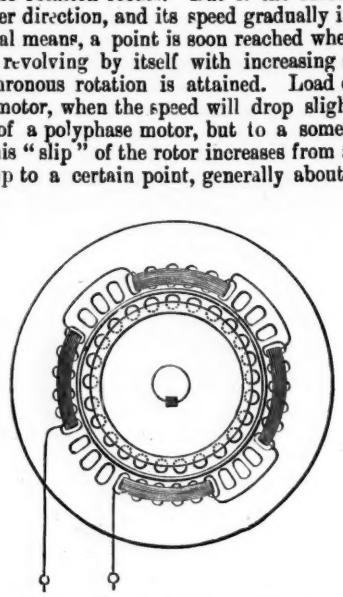


FIG. 4.—SIMPLE INDUCTION MOTOR.

load, when the motor runs out of step, and must be restarted. The slip is the frequency of the rotor currents, and hence the effect of loading the motor is to cause such a slip as will increase the rotor currents by such an amount as will correspond to the necessary increase of torque.

The theory of the single-phase induction motor is necessarily somewhat complicated. The best treatment of the subject is that of the late Prof. Ferraris, it consisting in considering magnetic fields as vector quantities, capable of being combined as ordinary vectors. According to this, an oscillating magnetic field may be considered as being the resultant of two rotating fields of constant and equal strength, and rotating in opposite directions with the same frequency as that of the oscillating field. If the oscillating field follows a sine law, then such a field of maximum strength N, and with p poles, oscillating with frequency n, may be represented by two sinusoidal rotary fields of p poles and maximum strength $\frac{N}{2}$, the one rotating forward, and the other backwards, with a speed of $\frac{n}{2p}$ revolutions per second.

It is not difficult to show that any distribution of field of p poles may be decomposed into a number of multipolar sinusoidal fields. There would be (1) a fundamental sinusoidal field of maximum strength N_1 of p poles, (2) a first harmonic sinusoidal field of maximum strength N_2 with $2p$ poles, (3) a second harmonic sinusoidal field of maximum strength N_3 with $3p$ poles, and so on. Hence it follows that any oscillating field, such as might be produced in any form of single-phase induction motor whatever, may be decomposed into a number of multipolar sinusoidal fields of different maximum values with different numbers of poles, and rotating, some forward, some backward, with velocities inversely proportional to the number of poles.

It is to the forward rotating field or fields that the rotation of the motor of a single-phase motor is due; this forward rotating field acting on the rotor in every respect just as the rotating field produced by a two or three-phase current acts in multiphase motors. That is to say, the torque on the rotor is due to the fact that the rotor field produced by the induced rotor currents follows up the forward rotating field, never quite catching it up, but having a certain slip with regard to it, this slip, as previously pointed out, increasing with the load, and is, of course, equal to the difference between the frequencies of the forward rotating field (frequency of the supply current), and the rotating field of the motor $\left(\text{which is } \frac{\text{number of motor poles}}{2} \times \frac{\text{revolutions per minute of rotor}}{60}\right)$.

Now this mode of treatment readily lends itself to the solution of the usual problems connected with induction motors. Some years ago it was shown by Mr. M. B. Field that it could be extended to the ordinary Kapp diagram for multiphase motors,* and that by constructing such a diagram with the forward and backward fields, the performance of the single-phase induction motor in regard to efficiency, power-factor, torque, &c., can be predicted if certain constants are known. The present writer hopes shortly to be able to go fully into this method of Mr. Field's in another place, as it should prove of considerable value to all those having an interest in this class of alternate current plant.

(*To be continued.*)

ERRATUM.—In fig. 2, which appeared last week, a slight error occurred. We reproduce the block below with the correction made. The top right-hand switch blade marked * was omitted from last week's block.—EDS. ELEC. REV.

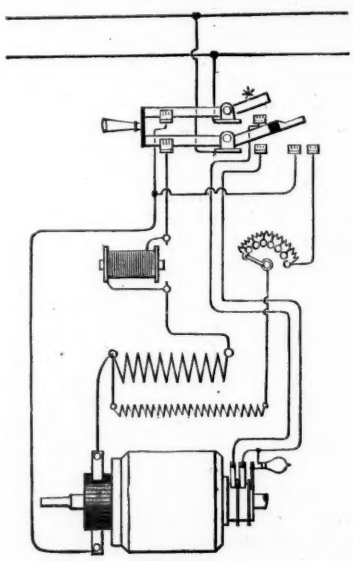


FIG. 2.

SHIELDED CONDUCTORS.

BY W. A. PRICE.

(*Concluded from page* 63.)

MR. MORDEY'S suggested explanation of Prof. du Bois' observation published in the *Phil. Mag.* for December† is difficult to understand. He attributes it to the fact that a ring solenoid is equivalent magnetically, so far as the external field is concerned, to a single turn laid along the circle that forms the axis of the helix, but how such a ring can experience a side thrust in a magnetic field is not easy to see. One would expect only a tendency to turn into a plane perpendicular to the field.

Mr. James Russell describes also a number of interesting experiments on the forces exerted on a conductor carrying current in a magnetic field, when shielded by an iron cylinder. In one of these an iron tube is placed in an uniform magnetic field perpendicular to the tube, and a conductor is placed in the axis of the tube. On starting a current in the conductor, the iron shield tends to move sideways, *i.e.*, at right angles to the field and to its own length, while the conductor experiences little or no force. Considered in connection with the action on the magnetised ring (fig. 4) the result seems paradoxical, *i.e.*, if this action be what we suppose, and Prof. du Bois is mistaken; for the effect of the current on the iron tube is to magnetise it circularly, and to produce motion sideways, while no such motion occurs with a permanent ring magnet of the same form.

* See Kapp's "Power Transmission," page 346.
† See ELECTRICAL REVIEW, January 7th, 1898.

The explanation lies in the action of the current on the field outside of the iron tube, which is distorted by the current exactly as if the iron shield were absent, and is not affected by the circular distribution in the ring itself. In fact, though the iron tube shields the conductor inside it from the action of the outside field, and prevents any force from acting on it, it does not shield the outside field from the action of the current in the conductor. It seems possible that Prof. du Bois, in his experiment on the magnetised ring, may have led his current in such a way as to distort the field, and so produce the action on the ring, an action which would be more intense if the ring were not permanently magnetised, and more permeable.

Fig. 5 shows the character of the distribution of the field

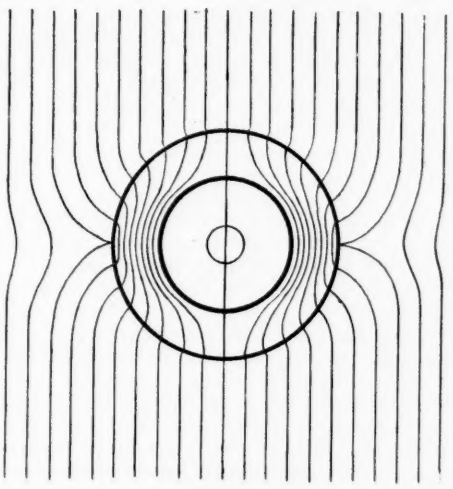


Fig. 5.

when no current is passing in the conductor. It is, of course, similar to fig. 3. Fig. 6 shows the field when a current is passing, and the field is disturbed outside the shield, tending to move it in the direction of the arrow. Comparisons of figs. 4 and 6 shows the difference between the conditions of

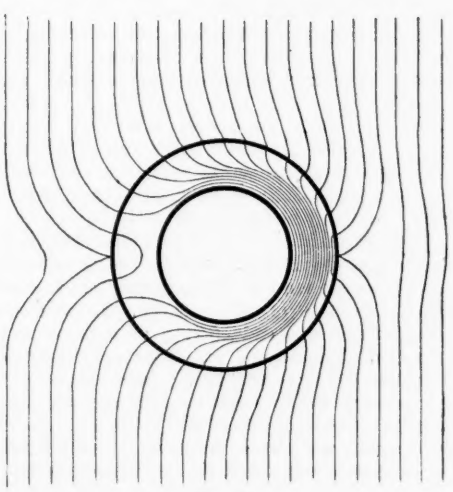


Fig. 6.

Mr. Russell's experiment and the one we understand Prof. du Bois to describe.

Another point requires notice. A law of refrangibility has been repeatedly referred to, viz., that the ratio of the tangents of the angles made by a line of magnetic flux with the normals on two sides of a surface separating two different media is equal to the ratio of their permeabilities. This only applies when neither medium is coercive, and the field of magnetic force is continuous at the surface in question; *e.g.*, suppose in diagram fig. 7, A A, B B, are infinite plane current sheets, A A coming up, B B flowing down normally to the paper. The space between A A, B B, is an uniform magnetic field in the direction of the arrow. Now, if the whole be placed in an uniform field perpendicular to the sheets, the lines of flow will take the direction shown in

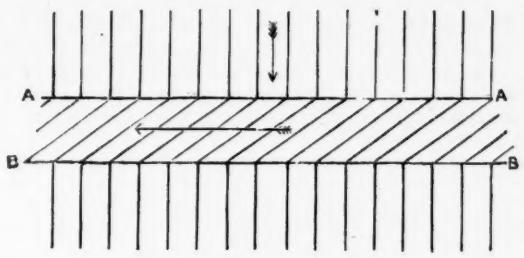


Fig. 7.

the figure, each of them bending sharply where they cross the current sheets, though the whole space is equally permeable.

So where lines of flow enter hard magnetised steel the law does not apply, and since all iron is coercive, and other materials have practically the same permeability, the law is little more than a guide in drawing freehand certain classes of diagrams.

It is not suggested that the writers who have referred to this law are not familiar with its limitations, but when laws are formally stated one is apt to think the statement is also complete.

I am tempted to suggest another paradox. A space is enclosed by a shield formed of bar magnets placed side by side with all their north poles outside, and all their south poles inside. There can be no flux, and they consequently cease to be magnets.

For a simple case, consider the space enclosed between two infinite plane magnetic shells (fig. 8). Along N N, N N,

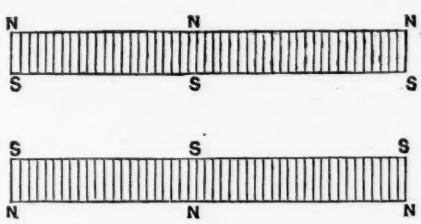


Fig. 8.

are north poles, and along S S, S S, south poles, the shells being made of small bar magnets placed side by side. There is no magnetic field anywhere. Have the bars ceased to be magnets?

WINDINGS OF POLYPHASE ARMATURES.*

By J. P. STONE.

With the introduction of polyphase apparatus, a number of different windings have necessarily been developed, although all of them have the same general features. Since they are slightly different, it may be thought that they are of essentially different character. It is the object of this paper to

Fig. 1.—Single-Phase Winding.

illustrate how these windings are made, and to show that it is rather unessential what type of connections are used as far as behaviour and output of machines is concerned.

* *American Electrician.*

The single-phase winding in its simplest form consists of a number of coils connected up so as to give alternate polarity all round the surface of the armature. Assume that an alternator has 10 poles, we could thus have a winding consisting of 10 coils, as illustrated in fig. 1, each coil connected in reverse direction in regard to the preceding; or we could have a winding as illustrated in fig. 2, consisting of five coils, which coils are connected so as to give the same polarity, but separated from each other by the pitch of the poles—that is, by the distance between two adjacent poles.

Necessarily, if all coils are connected so as to give the

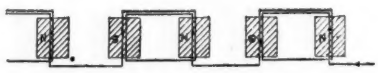


FIG. 2.—SINGLE-PHASE WINDING.

same polarity, the space between the coils will have the opposite polarity to that given by current passing through the coil.

A two-phase generator could be made from a single-phase generator by adding a set of new coils placed midway between the first coils and wound in identically the same way as the first winding. Since the distance in phase

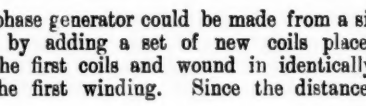


FIG. 3.—TWO-PHASE WINDING.

between two adjacent poles is 180°, it is evident that the beginnings of the two independent windings will be 90° apart; thus, if the two windings have the same number of turns, the generator will have two independent sources of power of same magnitude, one displaced 90° from the other, that is, we have a two-phase generator with independent

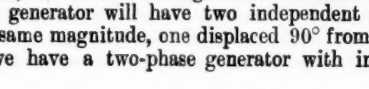
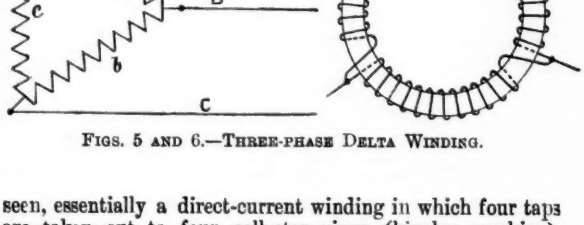


FIG. 4.—THREE-PHASE WINDING.

windings. Such a machine would then, of course, have four collector rings, two for each of the windings. By connecting two adjacent collector rings together, a two-phase relation still remains, and we have a two-phase machine with interlinked windings.

The same results can also be obtained from a distributed single-phase winding by proper connections, provided that the number of coils between each pair of poles is divisible by two. Such a winding is illustrated in fig. 3, and is, as can be

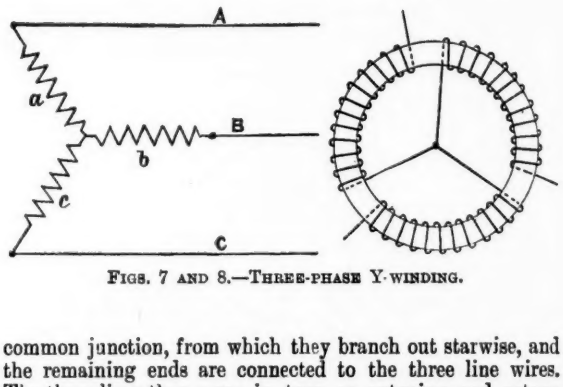


FIGS. 5 AND 6.—THREE-PHASE DELTA WINDING.

seen, essentially a direct-current winding in which four taps are taken out to four collector rings (bipolar machine). Thus no new features in winding are introduced in making a two-phase generator.

A three-phase generator is made on essentially the same plan. It consists primarily of three independent single-phase windings, such as are described in fig. 1 or 2, each starting 120° in phase from the preceding; that is, since the distance between two pairs of poles is 360°, if the first winding starts midway under one pole, the second winding, wound identical with the first should start at one-third of the distance between two poles and the third at two-thirds the distance between the poles. Thus we see how a three-phase generator can be wound. If these circuits are not joined, six collector rings are necessary, two for each phase. Since, however, each winding has a point of equal potential with either of the other two, that point can be connected on all three.

That is one end of each of their windings is brought to a



FIGS. 7 AND 8.—THREE-PHASE Y-WINDING.

common junction, from which they branch out starwise, and the remaining ends are connected to the three line wires. The three lines thus serve in turn as outgoing and return circuits, the maximum current shifting from one to the other in succession. We thus obtain a Y-connected machine which necessitates three collector rings only.

Similar to what was stated regarding the two-phase winding, the three-phase winding can be obtained from the distributed single-phase winding by tapping the winding at suitable points; that is, points differing in phase by 120°. Such a winding is illustrated in fig. 6, and is called the delta winding. This is also shown diagrammatically in fig. 5. Here the coils form a closed mesh, the six terminals being united two and two, the lines being connected to the windings at the three points of junction, forming a triangle. In order to make such connections, however, it is, of course, necessary that the single-phase winding should have at least three slots per pole and phase (for a full pitch winding) or a multiple of 3. Such a winding is illustrated in fig. 4.

The three-phase windings can also be shown as simple Gramme windings, having only one coil per phase, as in figs. 6 and 8, which are shown delta and Y-connected, respectively. Thus it will be seen that a direct-current winding may be connected into a three-phase delta-connected winding by tapping it at equidistant points, the number of leads being governed by the number of poles.

Denoting the E.M.F. induced in each winding by E, it is evident that the E.M.F. between the lines in a delta-connected armature must be E, since the lines are connected directly to the ends of the winding. In a Y-connected armature, however, one end of each of the three windings are connected together, and the other three ends are connected to the lines, as in fig. 7; but since the E.M.Fs. induced in each winding are not in phase with each other, the E.M.F. at the terminals is not the sum of the E.M.Fs. induced in each winding; that is, it is not 2 E, but is the geometrical sum of the E.M.Fs. in the two phases—that is $E\sqrt{3}$.

The output of a polyphase generator is that of the sum of each individual phase; that is, denoting the current in each wire in a Y-connected motor by C, and the E.M.F. induced in each phase as before, by E, the power of the three-phase generator is $3 \times C E$. Since, however, the E.M.F. between the lines is $\sqrt{3}$ times the E.M.F. per phase—that is $E \times \sqrt{3}$—we find that the power of a three-phase generator expressed by the line E.M.F. and line current must be $\sqrt{3} \times C_1 \times E_1$, where E_1 and C_1 and the E.M.Fs. and the currents, respectively, between the lines and in the lines. In a delta-wound motor, in the same manner, we find the power delivered to be expressed by the same equation.

(To be continued.)

THE TRANSFORMATION OF ENERGY IN THE ELECTRIC ARC.

THE mechanism of the conversion of electric energy into heat in the electric arc still evades the inquiries of experimenters, but papers are from time to time published dealing with the subject, and new suggestions made, and new conclusions reached, without any conspicuous approach to an explanation of what occurs. Mrs. Ayrton's laborious and systematic observations are in recent years the most important of these contributions. Of course, "explanation" in such a case as this means no more than that the phenomena are shown to be subject to laws and conditions which are ascertained and well recognised in other cases, even though the mode of action in the latter may be quite obscure. The reference of the planetary motions, and the weight of terrestrial bodies, to one law of the attraction of gravitation, is called an explanation of these phenomena, though the mode of attraction is not less obscure than the phenomena it explains, and the very idea of action at a distance may be abandoned as a misleading fiction. Following a course of this kind, one experimenter after another has attempted to find laws for the behaviour of the electric current in the arc, similar to those which it obeys in a metallic conductor.

Electricity flowing through a metallic conductor generates heat at a rate proportional to the square of the current, and the independence of that coefficient, which is called the resistance, of the amount of current passing, is so conspicuous a property of metals and their alloys that it seems to indicate some marked characteristic in the mechanism of their conduction. So when a current of electricity flows through a junction of two different metals heat is developed, or absorbed, at a rate directly proportional to the current; and here again the coefficient involved, viz., the electromotive force of contact, is a physical constant not less significant than the resistance. The molecular structure of metals is unaltered by the passage of the current, and no transfer of matter takes place.

This last property clearly differentiates the mode of conduction by metallic conductors from that by the arc, where disruption and transfer of matter occur. The *primâ facie* improbability is very great that conduction by the arc is regulated by laws similar to the peculiarly exact and simple ones which apply to metallic conductors. All attempts to represent the heat developed in the arc, as due to a resistance and a back E.M.F.—or, in other words, to express it as the sum of two terms containing the first and second powers of the current respectively—have been futile, and it appears unwise to persist in attacking the question on these or similar lines.

If the arc consists of molecules, torn from the positive carbon, employed in the incessant to and fro bombardment of the poles, carrying positive charges to the negative, and negative charges to the positive carbon, the mode of transference of the charges is by convection and not by conduction; and an attempt to represent the action in terms of the ideas used for metallic conduction, is analogous to an attempt to enter the statistics of a town supply by water carts on printed forms arranged for the data of a pipe supply.

An observation that under certain circumstances an increase of current in the arc is accompanied by a diminished potential difference between the carbons led the observer, drawing too closely the analogies with metallic conduction, to the absurd conclusion that the arc possesses negative resistance. No portion of the heat generated in the arc has been traced to a distinct cause involving transformation of energy proportional to the square of the current; and we have no ground for assigning resistance to the arc.

Prof. Fleming, in a letter to the *Electrician* of January 7th, considers the probability of the existence of a "counter electromotive force in the arc," and makes an interesting suggestion as to its possible source. It is not quite clear what idea is expressed by the words "counter electromotive force." They must mean something more than a means whereby electrical energy is converted into heat in direct proportion to the current, and seem to imply that the action is reversible, and to some extent elastic, so as to produce an E.M.F. in the reverse sense, if only for a very short time, on the sudden cessation of the main current. Such an action has been looked for repeatedly in the arc, but never, we believe, detected. It occurs in every other case we can call to mind, to which the term "counter electromotive force" is applied. It is not obvious why it should be looked for in the arc at all. An elastic action implies a return from a more to a less strained condition, and if the energy in the arc is employed in the disruption and mutual bombardment of the carbons, no reversible effect is to be expected.

Prof. Fleming suggests that the current may generate heat in direct proportion to its amount when passing from a hot point to a cooler one in carbon vapour, by analogy with the Thomson effect in copper, or solid carbon; the existence of a difference of temperature in the carbon vapour being inferred from the difference of temperature in the carbon rods at the arc. The explanation requires carbon vapour and solid carbon to be in contact at two very different temperatures at the same pressure, and to have very different thermo-electric gradients; since if the gradients were the same, the total development of heat, by a Thomson effect, between the distant ends of the carbons, which are at the same temperature, would be zero. The latter condition may be satisfied: we have no knowledge of the matter; but it is hard to see how two very different temperatures can be found in a small body of vapour, presumably saturated. The existence in hot gases of an effect similar to the Thomson effect in solid conductors is only guessed at, but it offers an interesting subject for experiment. If this effect is found in carbon vapour, electromotive forces between the solid and gaseous carbon might exist at the contact surfaces, similar to the Peltier effect in metals, and the energy converted at those points might be expected, by analogy, to be considerably greater than that due to a difference in the thermo-electric gradients in the solid carbon, and in its vapour.

It may be observed here that the reduction in the potential difference of the carbons for a given current, by heating the negative carbon, is explained by the bombardment hypothesis, as well as by Prof. Fleming's.

Observations on the distribution of potential in the arc are difficult to interpret, but it appears that the difference of potential between the central part of the arc and the negative carbon is small or zero, and that the whole fall of potential in the arc takes place at or near the positive crater. At this point disruption of matter is taking place, and the generation of heat under these conditions and the generation of heat by a Peltier or Thomson effect, where no change occurs in the condition of the matter concerned, seem phenomena, *primâ facie*, to be placed in very different categories. It would seem that little assistance in this question is to be expected from analogies drawn with the phenomena of electric conduction in solids. The phenomena seem rather allied to those of discharges in rarified gases, and movements in electrolytic solutions.

CHEAP ELECTRICITY.

THE presidential address of Mr. Raworth to the Northern Society of Electrical Engineers comes in for a good deal of satire from the *Engineer*, which is rather solemn in its treatment of most questions, and is very severe upon Mr. Raworth. Perhaps it is that the writer has a sneaking envy for the optimistic breeziness of Mr. Raworth. Our contemporary, however, cannot at all put up with such breeziness, which is even in parts of doubtful seemliness in its humour. The comparative absence of figures does not meet with approval. In a presidential address figures are not much wanted. Too many such addresses are but at best gracefully connected recapitulations of well-known facts.

It is with such few figures as were given that the *Engineer* falls foul. Mr. Raworth suggests a 50,000-H.P. power plant to earn £200,000 a year gross, or at the rate of £4 per H.P. We are asked to see how much each horse-power will cost. Coal will run to 3 lbs. per E.H.P., so that 1 ton would yield 750 H.P. hours, and a year of 7,300 hours—rather a long year, for it means 20 hours a day—will cost 9·73 tons of coal, or, say, 10 tons, costing £2 10s., which is too high a proportion of the selling price of current to warrant much hope of a profit after other expenses are paid. But after all, did Mr. Raworth mean days of 20 hours.

If not, and 10 hours' days were meant, the coal would be reduced to £1 5s.

The *Engineer* considers 5d. per unit as a low limit of price. Yet one London company is now offering current for power purposes at rates of as low as 2½d. per unit, so that there are those who consider 5d. an excessive price. The *Engineer* begs the question, when it cavils at the claim that electricity will be produced more cheaply than now. How can there be much reduction when dynamos already have an efficiency boasted of at 90, or even 98 per cent. Yet even the *Engineer* admits a possible cost so low as 1½d. per unit, with engine and dynamo alone. For ourselves, we look upon the future of electricity very hopefully. Its chief objection is its first cost of installation for small units. The rules and regulations, the claimed rights and arbitrary privileges of electrical supply companies, more than vie with any gas company. Especially is the power of cutting off supply without notice a clause which ought to be carefully considered. The small prospective consumer is apt to be scared off by the ponderosity of the demands upon him. True, he may be going to effect an economy by using electricity, yet, for all that, he does not relish being treated by a new electrical company as though they were conferring a huge favour on him by selling him current.

Electricity may not be so cheap as Mr. Raworth would make it out to be, but it will not be so dear as the *Engineer* would have us believe, but in either case the Leeds figures, which we publish in another part of this issue, are instructive. As we write we have in mind a works where steam is now the motive power, and is costing anywhere from £50 to £100 per annum. It costs this whether one or six machines are run. As a rule, one, and that the smallest, is the machine most run, and that only for half the day. At 6d. per unit, it ought not to cost above 6d. daily to run that machine, or, say, £8 annually. It is hardly likely that such a user would not gradually extend the system to all his machinery, besides becoming also a customer for light and even for heating. It is impossible to read what has been effected in electrical driving in America to perceive that it is in the electricity which is not used that the saving comes. It is the shaft that is not revolved, the boiler feed-pump stopped, the forge-fan which stands still when the work is on the anvil, the grindstone which stands when not being used, the long steam pipe not condensing steam, the oil, the belting, the waste, the dirt and inconvenience, it is all these negatives which show a commercial economy in expensive electricity. Doubtless Mr. Raworth sees this, and feels breezy about the prospects.

For large powers, we do not think it likely that electricity will be generated very far from the centres of coal production. Long distance transmission is not yet perfected, nor are line losses yet minimised. The use of gas engines with producer gas, or worked by the waste gases of huge blast furnaces, may change the whole condition of the industry. To use gas from a blast furnace demands a much smaller outlay than the preparation necessary to use a Niagara or a Foyers. Our contemporary is too apt to look on things as they are, in place of as they are becoming. It may not be wise to prophesy until we know, but the determination to have things as we wish them to be is almost akin to prophesy. Indeed, a clear perception of existing facts may warrant an expression of opinion that is not so much prophetic as far seeing.

AN ELECTRICAL HYPOTHESIS FOR THE SOLAR AND PLANETARY SYSTEMS, AND SOME OF THEIR ASSOCIATED PHENOMENON.

By DELTA.

WHEN great astronomers so widely differ in their hypotheses to explain the solar and planetary systems as to lose their good manners—instance Lockyer's reflections on Huggins—the audacity of an outsider in suggesting an explanatory theory quite distinct from either that of the waste by combustion or the nebulæ or meteoric hypothesis, will perhaps be forgiven. Merely as highly speculative hypothesis, it may, perhaps, be considered as at least interesting if only from the evidence of coincidence and correlation collected to explain the effect of electricity in producing many of the phenemenon that cluster around a subject of surpassing grandeur.

It is usually accepted by both schools of solar explanation that the sun is in a state of magnificent conflagration,* and that there is by its assumed contraction †—or by its internal combustion—a gradual waste of energy proceeding, that will ultimately close the sun's glorious mission as a centre of light and heat.

It is also assumed that such is the inconceivable effect of combustion or contraction in luminous and heat-producing intensity, that both light and heat rays are transmitted to the glittering planetary and stellar elements suspended in celestial space, some of which are computed to be hundreds of millions of miles from the solar orb, the earth's distance from the sun being estimated to exceed 95,000,000 of miles. Now, anyone who, like the writer, has had great experience in the production of relatively enormous fusion temperatures, will know that although the luminosity resulting from masses of molten metal, such as very low carbon steel, will project a beam of light extending, under certain atmospheric conditions, over a distance of five miles; nevertheless the sensible heat transmitted to any body that chances to intercept such a luminous beam, will not be perceptibly felt at a distance of even, say, 50 yards.

So that if this ratio of as 50 is to (1,760 × 5) were applied to the proportion of heat and light transmitted from the assumed burning solar orb, no heat, sensible to human life, could possibly be transmitted through all the enormous gulf of space that divides our planet earth from the sun.

It was this *à priori* reasoning that led the writer to doubt the *rationale* of existing hypotheses presuming to explain the solar and planetary system, and the doubt found expression in a communication, published in a technical contemporary several years back. In this it was suggested that although light and heat of the earth had their origin in the sun, it was quite inconceivable to the writer that there could be a loss of energy and drop of potential, mile by mile of the 95,000,000 of luminous and thermal passage, through which the solar rays have to traverse before they reached the earth. On the contrary, it was suggested that there would be no loss of the energy (producing heat and light at the earth) between the outer fringes of the atmosphere (or photosphere, chromosphere, and corona) of the sun and the atmosphere of the earth or any other of the planetary or stellar bodies in the celestial space, and that only in proportion to the actual sum of luminous and thermal energy entering the planetary atmosphere, and also in some ratio depending upon the density of such atmosphere—was such energy expended in the production of light and heat. To assume that light and heat is uselessly expended all through the distance intervening between the sun and the planets appeared to be quite inconsistent with any rational conception of the laws of the conservation of energy, and the hypothesis that all the enormous heat waste that must as a consequence follow the acceptance of such a theory, could be derived from the assumed burning out or contraction of the sun, or of the planets, appeared to the writer quite inconceivable and utterly impossible.

There are many other objections to the acceptance of the existing theory; for instance, it would involve the assumption that beams of light are emanating from the solar orb to all the planets, and these beams would be seen traversing the dark interplanetary space, exactly as we see the beams of an arc light projected from the lantern of a lighthouse at sea, even when the source of the light itself cannot be seen. The author's audacious experiment of forming an alternate and entirely electrical hypothesis is based on the suggestion already described, to the effect that there is *no loss of energy* between the solar and planetary atmospheres; the suggestion is amplified and extended as follows:—

(*a*) The solar orb is accepted as constituting the great distributing centre of light and heat, which is, however, not only generated in an *electrical* form, but is transmitted to the planetary and other celestial bodies electrically, and in *no* other kind of energy.

* The sun is assumed to be gradually burning itself up, but as such a combustion would involve a supply of oxygen, it is difficult to accept this theory as in any degree rational.

† There is no absolute proof of any reduction of the bulk of the sun's sphere.

(*b*) The entire interplanetary and interstellar or celestial space may be considered to be an electrical ocean of assumed low intensity potential (and constituting a magnetic field), permitting electrical currents of assumed high intensity and frequency to flow to all the planetary bodies in direct lines from the great central solar generating station.

(*c*) The planetary and stellar spherical bodies are assumed to be secondary conductors of a system in which the solar orb is the primary.

(*d*) The secondary spherical conductors are of a polar character.

(*e*) The planetary spheres absorb at their surfaces opposite the sun or facing the direction of the electrical flow the positive and high intensity electrical energy projected from the sun across the celestial interplanetary ocean of low electrical intensity. The surfaces of the planets that in their rotation are illuminated are those that absorb the high intensity electrical energy.

(*f*) The surfaces of the spheres away from the sun give up again the electrical energy (transformed down to low intensity) to the celestial ocean of low electrical energy of low intensity, the electrical ocean acting as the agent of compensation in the cycle of the conservation of energy. The surfaces of the planets that in their rotation are in darkness, are those from which the electrical energy is *given up* by the *planets* to the electrical ocean.

(*g*) The low intensity electrical energy of the celestial electrical ocean is, by the law of compensation, constantly being absorbed by the sun, or in proportion to the electrical energy of high intensity that is being projected by the sun to the different spherical, planetary, stellar and other conductors that dot the great immensity of the celestial electrical ocean.

Now let us consider the effect of this hypothetical cycle of electrical energy movement in its effect on the planetary bodies and on the sun.

Both the sun and the planets are, and with good reason, assumed to possess atmospheres or gaseous envelopes of varying density.

The electrical energy of high intensity or frequency flowing from the sun will be met, first, by the resistance set up by its photosphere or corona (which are merely atmospherical envelopes of varying density). The resistance set up by the sun's atmosphere promotes the grandly resplendent luminosity of the solar orb. Immediately the high intensity current passes over the extreme fringe of the resisting solar corona, or outer solar atmosphere, it flows unrestrictedly across the low potential electrical ocean, until it meets with the atmosphere of the planets, or other celestial bodies, stellar and otherwise.

From the time it leaves the solar atmosphere to the time of meeting that of the planets, no energy is assumed to be expended, and the electrical ocean is consequently neither illuminated nor heated,* and two conditions therefore follow the acceptance of this essential condition: the interplanetary space, or electrical ocean of low intensity is non-luminous, and is of low temperature†. Were it not so, and if the interplanetary space offered resistance to the flow of electrical energy, there would be a solar beam of light, and we should see such effects in vivid lines of light stretching from the sun to the planetary and stellar bodies.

(*h*) As soon as the electrical currents of high intensity enter the earth's atmosphere, *luminosity is produced*, and of an intensity and colour depending upon and controlled by the density and chemical character of such atmosphere.

(*i*) Associated with the production of luminous energy there is the generation of heat, and of actinic or chemically stimulating energy, both effects depending upon the density and chemical character of the atmosphere.

Thus the surfaces of the earth, and those of other planets that absorb by their *vis-à-vis* position to the sun the high intensity electric currents, are covered with an illuminated atmosphere, the luminousness of which is dependent upon the density of the atmosphere at any point.

For instance, the equator is in direct line, and consequently the atmosphere at this point offers less length of passage to the flow of the electrical current, and the luminous and thermal production effect is thus *pro tanto* more concentrated than in the distances away from the line of least resistance.

The tendency of electrical currents to flow along lines of least resistance will have, in its effect on the direction of the current, the influence that refraction is assumed to have upon the direction of light rays.

The high intensity electrical energy, lessened somewhat by expenditure in producing heat, light, and chemical effects, flows into the earth,* and it is then by some internal and intermolecular influence, and perhaps by resistance culminating in internal fusion, converted into low potential, and in this form it flows to the opposite surface to that which it entered, or to the poles, and finally flows from the dark surface of the earth into the great compensating element, the electrical ocean of low intensity. Owing to its low and partly-expended intensity, it is incapable of elevating the resisting atmosphere to a condition of a luminosity sensible to the human retina, hence the phenomenon of night.

The expenditure of electrical energy is assumed to be exactly compensated for by thermo-dynamic electrical influences, by electro-chemical effects, and by thermo-electrical influences. The low intensity electrical ocean entirely surrounds the planetary and stellar bodies, so that any cause effecting a supply of the primary energy is absorbed into and assists in compensating for its expenditure.

The degree of the luminous effect is directly proportionate to the density or resistance of the atmospheric obstacle.

We know that if it were possible to produce an absolute vacuum between two separated terminals of opposite polarity, that an electric current would flow from one to the other, without involving any loss of energy, and consequently neither produces luminous or thermal effects.

The high intensity electrical currents as they flow into the earth in a circumscribed area, the centre of which does not correspond with an imaginary line drawn across the centre of the sun and the earth, might be imagined as capable of setting up the rotative action of the sphere, in some way similar to the tangential influence of an electric current on the drum armature of an electric motor (*vide* notes on wind currents). If the electrical energy of high intensity met the earth in equal intensity on both sides of a line imagined as drawn across her axis there could be no rotation, but we know, by the marvellous scheme of the Great Creator, that this is not the case.

The double planetary rotation might be explained in the same way.

The electrical, or magnetic, attractive influence of the sun, which we shall call gravity, on the earth is assisted by the suggested theory outlined.

It has been suggested that there are dynamo-electrical influences that are producing electrical energy to compensate for that absorbed on reflecting the rotation of the celestial planetary spheres, so that the loss of energy by rotation does not interfere with the completion of the cycle of conservation of energy. We know that the electric energy flows across a vacuous space without producing light or heat, but as soon as a gaseous intervening medium is introduced *heat* is produced, and with it a luminosity of varying colour and beauty, corresponding to the specific density of the intervening or interpolating gaseous medium. A gamut of colours is produced until the density corresponding to that of the atmosphere is reached, then the colour is daylight white. A

* Exact evidence.—On July 29th, 1878, and under satisfactory conditions, there was observed in North America a total eclipse of exceptional duration. Although no exceptional prominences were visible, the corona had a pair of enormous equatorial streamers that stretched east and west of the sun. They were best seen with the naked eye.

The solar poles were also equipped with straight *electric-looking brushes of luminous rays*. The sun at this time of the observation was in a state of profound tranquility.

Grooch noticed in 1867 the same equatorial extensions and polar electric-looking brushes of light.

† So from the extremely low freezing temperature of the interplanetary space it is very necessary to say that the Cirrus clouds, only some 5½ miles distant from the earth's surface, are composed of snow particles.

Comets have been discovered coated with ice, and in some instances internally frozen, although the outer surface had been heated up by their frictional contact with the atmosphere when travelling at a terrific velocity.

* That electrical energy flows through and not merely over the surface of the earth would require evidence of an electric flow through siliceous material of which the earth is composed; recently Hertz rays have been sent through large cliffs of rock. It is, however, well known that a large portion of this, the substrata of the earth, constitutes an aqueous reservoir—an excellent agent of electrical energy distribution.

simple but imperfect example of this is the arc light, the flash and the fork lightning. All the colours that one sees in experiments with vacuum tubes are reproduced in the earth's atmosphere. The celestial blue of the heavens, the violets, the amber-yellows, the strange and ghastly greenish tints associated with lunar effects, the colours of the fixed stars and those emitted from the solar corona, all can, it is believed, be produced by varying the density and gaseous character of the gaseous environment and intervention of two terminals of opposite polarity, and across which then flows a highly intense electrical current.*

That the earth, being a polarised conductor, is a distinctive magnet, and acts as such in its relations with the moon, is very likely, and as the instance of the earth's magnetic field in an electric ocean of low intensity can be compared to the magnetic field of an ordinary alternating dynamo, in an electric environment of low intensity there should be little difficulty in imagining that the rotative influence of the earth might set up incidental movements of rotation of the moon—movements, however, that may be influenced by the magnetic attraction of the great central solar electrical influence.

The peculiar ghastly luminosity of the moon can be easily produced by effecting an electrical discharge, through a highly tenuous gas, it can also be seen as a reflection of the almost invisible brush currents leaving one of the terminals of an electrical (plate) or other frictional machine.

There is no evidence to *disprove* that the moon is surrounded with a highly tenuous atmosphere corresponding to that by which the lunar brilliance can be imitated in a Crookes's or Geissler's tube.

It may be argued that the sun constantly transforming, as it is assumed to do, sufficient of the surrounding low intensity electricity of the electrical ocean into currents of high intensity, must show *non*-luminous evidence on her surface of the entrance into the great solar transformer and conductor of such compensating low intensity currents, because, inasmuch as the low intensity electrical currents flow into the sun, the sun's atmosphere at the points of absorption would be *non-luminous*. Unfortunately, the surface of the sun is radiating current of high intensity to innumerable points in the celestial electrical ocean, and the reflecting influence of the luminosity of the corona would illuminate some portion of the solar surface which is absorbing electrical energy of low intensity, in some degree commensurate with that which it is transforming and emitting at a high intensity; but even allowing for this incident reflection, one may point to the evidence of dark places on the sun's surface, which may be spots and blemishes on an otherwise grandly luminous face; but if this theory were accepted as correct, they would be spots sustaining a never-ceasing energy fecundity, and would constitute the most sublime *blemishes* of beauty ever conceived by man.†

The *periodicity* of the *sun spots*, and the fact that they influence the electrical (or magnetic) condition of the earth's atmosphere, are evidence that the writer's theory has some basis of fact.

The flashes of light that are thought by some to be tongues from a colossal combustion, are suggested to be merely evidences of variation in the density and extent of the solar atmosphere (photosphere and corona). The flashes, or ragged atmospheric edges, may be merely evidence of the projecting influence that the emission of the outflowing currents has upon the sun's atmosphere.

Whatever the constitution of the solar envelope illuminated by its resistance to the outward flow of electrical energy may be, the spectroscope should show its character, should it not? That is, if such an instrument can be relied upon for this purpose, it should show that the gas giving a specific colour tint, owing to its resistance to high intensity currents, should have a specific density, if it is assumed to be *hydrogen*, then red is the *tint* that should be shown when this gas intercepts the high tension rays flowing between two terminals of opposite polarity. We know that this is the tint, so here we have a coincidence of spectroscopic and electrical resistance effect of some value.

* A high potential or intense electrical discharge produced by a Holtz machine or a Ruhmkorff's coil shows that the luminosity of such discharge varies in colour in some definite ratio as to density; for instance, ordinary atmospheric air gives a white light with a blue image, the latter not unlike the celestial blue of a clear day. Nitrogen gas, which constitues some 75 per cent. of the atmosphere, gives a blue tint, whilst hydrogen gives a red one, and carbon dioxide a green tint. It is strange that this latter gas, that feeds plant life, should give the green tint of leaves. The incandescent vapours of gases giving characteristic Frauenhofer's dark lines, would, it is thought, give the same lines if rendered luminous by resistance to the passage of electrical energy of high intensity. In June, 1897, Sir William and Lady Huggins by artificial means had shown that calcium vapour when sufficiently attenuated radiates, under electrical stimulation, H and K lines alone, and this precisely coincided with the spectrum of the solar prominencies.

† Evidence.—Prof. Langley diagrammatically shows the correlation of sun spots with great magnetic variations in the earth.

Exact correspondence has been noticed between the sun spot influences in producing violent commotions in the sun and electric storms in the planet earth.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

AT the meeting of the Institution of Electrical Engineers, held last Thursday, the 13th inst., at the Institution of Civil Engineers, a numerous company assembled to listen to the address of the new president, Mr. J. W. Swan. We noticed many faces which are not usually to be seen at the meetings. Chemists and physicists mustered strong in numbers to hear what an able chemist and electrician had to say on matters lying in the borderland between the sciences of chemistry and electricity. Nor were they disappointed, for the address suggested that electrical engineers have now a wide field for the disposal of plant in the domain of electro-chemical operations, which it is as much to the interests of the profession to work as the older business of lighting and the later outlet for electrical traction appliances.

The first serious business of the evening was the presentation by Mr. Latimer Clark to the Institution of a series of volumes containing important papers relating to the early history of submarine telegraphy and the work and labours of the late Mr. Jacob Brett. In offering these volumes to the members, Mr. Latimer Clark desired to draw attention to their contents and give some idea of the importance of certain memoirs included in the set. The remarks occupied a few minutes, which certain members present seemed to begrudge because the time was devoted to telegraphic rather than electric light interests. It was a great pity that any unseemly conduct should ever be permitted to mar the harmony of an offering to the library, but Mr. Alexander Siemens stepped into the breach, and at the right moment pointed out that to many of those present such things were of very great interest. He might have added that the meeting was one of electrical engineers, and not merely of electric lighting experts. Major Flood Page suggested that the presidential address was of first importance, but the majority evidently realised that there was ample time for both matters to be laid before the Institution.

Prof. Ayrton in a pithy speech characterised the best of Mance's methods as being Mance's method of filling the presidential chair, while the vote of thanks to the retiring President, Sir Henry Mance, was well seconded by Mr. A. A. Campbell Swinton in a few appropriate words, and the meeting settled down to listen to Mr. J. W. Swan, who took the chair.

Like most addresses, this may perhaps best be appreciated by a quiet study of the numerous points raised, when it is in print. The ground covered was so large, and the topics introduced so numerous, that the listener could merely follow the reader, without fully realising the truth and importance of much that was said.

As was anticipated, the first reference was to the meeting of 16 years ago, when, with Mr. W. H. Preece in the chair, one of the very first practical exhibitions of incandescent lamps was given, with the then Society of Telegraph Engineers and Electricians as audience, Mr. Swan as demonstrator, and Mr. Radcliffe Ward as engineer-in-charge of a farmyard engine and Gramme dynamo, the enthusiasm of the members was raised to a high pitch as the lamps lighted up. That occasion was the beginning of a movement that has always gone on, and has incidentally given an impulse to a larger and more general use of electricity.

The beneficial change from depressing darkness to brilliance almost rivaling that of day has, of course, partly been due to the arc light, but the unwonted brightness is not distantly connected with the insignificant looking bulbs that are such familiar objects now. The entire space between the early demonstration and the present day has been crowded with electrical invention and electrical work. Successful electric lighting and improvements in machines gave an impulse to a broadening of the applications of electricity. Telegraph engineering continued to grow up, while traction and power came more and more into prominence. Another growing industry is that of electro-chemistry, and this Mr. Swan regards as being of especial interest to young electrical engineers, as, in his opinion, aspirants would choose wisely in making a special study of the applications of electricity to chemical manufactures. A small portion of the field only has yet been cultivated, but this has already yielded good results. Copper, aluminium, gold, chlorine and soda are now obtained electro-chemically, while many other successful processes besides those employed in connection with the substances mentioned are at work on an electrical basis.

The importance of electrical processes is great and constantly increasing, either as an improvement upon known or existing machinery, or in the way of new methods being invented: in the one case, to do better what was already being done, and in the other, to achieve something previously unattempted. Considering the importance of the subject, Mr. Swan thought that the time at his disposal would not be ill spent in considering the rise and progress of electro-chemical industries.

The main portion of the address was now to follow. After briefly referring to the early work of Carlisle and Nicholson, Davy—"fortunate in almost everything, was supremely fortunate in his assistant"—and that assistant, Faraday—"the inheritor of Davy's methods and work"—Mr. Swan mentioned that in 1842 there were at work in Birmingham machines supplying current for the electro-deposition of silver and gold. At the time the "dynamo had not issued from that mint, which by the coinage of a word seems to create the thing signified." Passing on the various processes for the refining, extraction, and deposition of copper, zinc, nickel, gold, silver, aluminium, and production of soda and chlorine, the production of phosphorous, carborundum, and carbide of calcium, a bird's-eye survey of the whole field was taken, and much matter likely to stimulate thought was presented. Due acknowledgement was made—as might be expected from Mr. Swan—that electric lighting has largely contributed to the degree of success which has been reached in electro-chemical work. Many points were casually mentioned which serve to attract attention to original researches. Thus the president has found that current densities of from 1 to 1,000 amperes per square foot of cathode surface may be used in copper deposition, provided that the condition of the solution and proper circulation be noted; the regularity and smoothness of the deposit depending principally upon the absence of solid particles in the electrolyte.

The descriptive portion of the address necessarily partook to some extent of the nature of a catalogue of known processes; as an index it must be highly useful, notwithstanding all that has recently been written on cognate subjects. In fine, everyone must admit that in choosing electro-chemistry as the principal subject matter of his remarks, Mr. Swan chose wisely, and did good service to those who have placed him in the highest position within their gift.

THE N.C.S. LOW RESISTANCE MEASURER.

The object of this apparatus, which is shown in general view and in diagrammatic form by figs. 1 and 2, is to supply a simple means of measuring very low resistances, which can hardly be determined by an ordinary bridge, owing to the difficulty of making the contacts, and other reasons. The method of working is to pass a current (which does not require to be known) through the resistance to be measured and a thick stretched wire on the instrument in series with it. The fall of potential over the unknown resistance is then balanced against the fall of potential over more or less of the thick stretched wire; the differential galvanometer mounted on the board being used for the purpose. The resistance to be measured when the balance is obtained is read direct by a pointer on a scale set at the back of the stretched wire. The length of the scale is one metre, and is

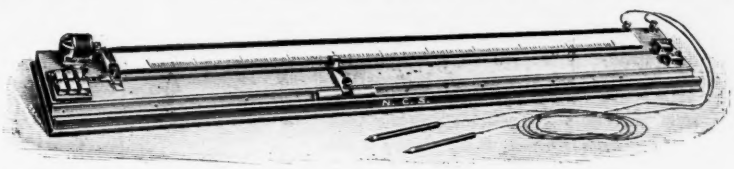


Fig. 1.

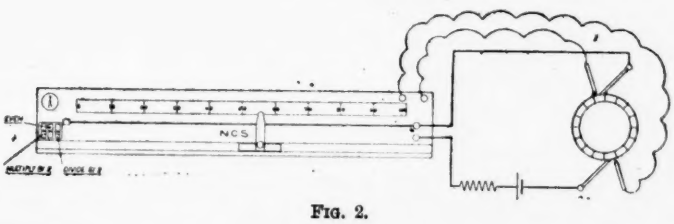


Fig. 2.

exactly equivalent to $\frac{1}{10}$th of an ohm; it is divided into a thousand parts, each of which is equal to $\frac{1}{10000}$th of an ohm. By shifting a plug the values may be multiplied or divided by 2, thus making the top read $\frac{1}{5}$th or $\frac{1}{20}$th of an ohm. (These plugs are in the galvanometer circuits; they are not in any way shunts on the main wire).

In using the instrument the terminals are joined in series with the resistance to be measured, and with a cell capable of giving, say, 10 amperes, a resistance, if necessary, being introduced to bring the current down to about 10 amperes.

The switch-key on the left, being depressed, closes the battery circuit. The sliding key is then slid along the wire, and manipulated as in the ordinary metre bridge, until balance is obtained on the galvanometer; the sliding key then points to the value of the resistance under test.

The whole length of the wire is ·1 ohm. The scale is numbered from 0 to 100, the readings being in thousandths of an ohm; each thousandth being again divided into 10. For example, if the read is (as in the figure) 56, the resistance is 56 thousandths of an ohm, or ·056 ohms. In the same way a read of 56·4 would be 56·4 thousandths, or ·0564 ohms; these are if the plug is in "equal." If the plug is in "multiply by 2," the resistance is $56{\cdot}4 \times 2 = 112{\cdot}8$ thousandths, or ·128 ohms. If in "divide by 2" it is $\frac{56{\cdot}4}{2} = 28{\cdot}2$ or ·0282 ohms.

It may be added that the resistance of connections does not affect the test in any way if a reasonably clean contact is made.

The whole instrument is certainly a very practical and serviceable one.

CORRESPONDENCE.

Practical Points in the Design of a Shunt Dynamo.

In your issue of 7th inst., No. 1,050, is first number of an article entitled "Some Practical Points on the Design of a Shunt Dynamo."

In the fundamental equation for finding the size of armature, having given the output, n is given as revolutions per *second*.

In the next equation, figures are substituted for letters, but the author then gives the revolutions per *minute*, viz., 320.

Will you kindly clear this point in one of your subsequent issues?

W. J. Axworthy.

In reply to Mr. Axworthy's letter, I regret that an error should have crept into my article. The first equation is of course wrong, as the 60 should have been omitted.

n = revolutions per second, and the second equation is multiplied by 60 for that reason.

V. Zingler.

On the Cause of Death by Electric Shock.

In the paper on this subject by Prof. Oliver and Dr. Bolam, which appears in the *British Medical Journal* of January 15th, the authors give tracings of blood pressure and respiration curves to show that death by electric shock is due to arrest of the heart's beat and not to respiratory failure. I, therefore, beg leave to draw your attention and that of your readers to the fact that this very matter was fully dealt with by me in a paper in the *British Medical Journal* of March 2nd, 1895. Anyone referring to that number will see that the experiments, the tracings, and the deductions drawn from them, all correspond exactly with those of the present paper, the only exception being that Prof. Oliver and Dr. Bolam used an alternating current, while I used a continuous. Although my paper has been overlooked by them, it is noteworthy that the authors refer to the existence of an opinion that death in these cases might be due to heart failure. That opinion was put forward in 1890 by Dr. Tatum, after experiments made by him, and it was supported and confirmed by the experiments reported in my paper of March, 1895, at a time when the profession generally was accepting the view of Prof. D'Arsonval that death in these cases was due to respiratory failure. It is gratifying to me to find that the experiments by Prof. Oliver and Dr. Bolam confirm so fully the results which I published in 1895, and show that alternating currents act in the same manner as continuous.

My paper was printed in the *British Medical Journal*, reproduced in the Electrical Review, embodied in a short paragraph in the second edition of my book on "Medical Electricity," and made the subject of a communication to the Physiological Society. Therefore no great amount of research is required to discover it.

H. Lewis Jones, M.D.

9, Upper Wimpole Street.
January 17th, 1898.

Dynamo Sparking.

Re the letter dynamo sparking, I think that "W. H. B." is wrong in adopting any such device as he explains for the automatic shifting arrangement for the brush rocker on his dynamo which he is using to supply current for motors. If he uses a solenoid with a movable armature, which in turn moves the brush rocker, I am of opinion that the same sparking will ensue as formerly. If the dynamo be running at a light load, and a motor is switched into circuit, a large current will have to traverse the coils of the solenoid to move the rocker, and during that moment sparking will ensue.

Now sparking between the gauze brushes and commutator will roughen the strips, and so make collection bad, accompanied with sparking, which increases as time goes on; and in a short time it will not stop, owing to the increased roughened surface of strips. Now I think it would be better for "W. H. B." to adopt carbon tips to the end of the brushes. The carbon will offer increased surface to collection (which will tend to decrease the volts, but not more than a fraction per cent.), and so render collection easier, with less sparking, and is less detrimental to the strips, as it takes over the sparking, and does not produce the burning and scoring effect as takes place with gauze brushes alone.

The tip need not cover more than a strip, or, if this will not suit, it would be as well to substitute the present brushes by those of carbon only, which I am sure if properly set and adjusted there would not be the least trouble with them.

There might be signs of sparking, but it will not be detrimental to the machine.

Carbon brushes need no little skill in adjustment; and if they are not properly set, they will prove worse than those of gauze.

I am sure if "W. H. B." would substitute for his brushes those of carbon he would be greatly relieved from trouble and anxiety by having sparking reduced to a minimum, and so by working his machine under fairer conditions, as carbon brushes allow of a large variation of load without altering the lead.

Charles Whinsa Nicholl.

"Dynamo-Electric Machinery."

May I draw attention to an error in Prof. Silvanus P. Thompson's valuable work? On page 434 of the fifth edition, it is stated that Mr. H. F. Parshall's 150 k.w. street-car generator has a duplex armature winding. From the other data given, however, it is evidently a single-winding; for, applying the formula given in Hobart and Parshall's "Armature Windings" (a formula, by the way, in which $\frac{n\,C\,N}{10^8}$ is reduced to more convenient terms) we find that for a single winding

$$\text{volts} = 5 \times 6{\cdot}16 \times 2 \times 8{\cdot}7 = 536,$$

which is approximately the required amount, whereas with a duplex winding

$$\text{volts} = {\cdot}25 \times 6{\cdot}16 \times 2 \times 8{\cdot}7 = 268.$$

I notice that nearly all the plates in the book have the scale given, which greatly enhances their value. Had this been done in the case of Plate X. (illustrating the machine referred to) one could have got at the induction and current densities, which would have enabled one to make interesting comparisons with other machines.

W. Casson.

January 14th, 1898.

[Should not ·25 in the second example (it is so in the MS.) be 2·5, otherwise the working out is wrong.—Eds. Elec. Rev.]

Lampholders.

As the expiration of the Ediswan patents on lampholders is coming on, it occurs to me it will not be out of place to sound a note of warning to fire insurance companies, through the medium of your columns, and I shall therefore be glad if you will give this letter a corner in your valuable Journal. Already samples of what we may expect are being put on the market, and as I write, I have before me the letter of a Government official, who says ever since the patents for the Edison screw holders expired, their department have had the greatest difficulty in getting satisfactory holders of this type.

My business takes me all over the country, so that I see work of all sorts, and I can assure you I have seen hundreds of lamps installed, both as to workmanship and material, in such a manner as would make Mr. Heaphy's hair stand on end.

The invariable answer I receive when I venture to point out the danger is, "Oh! the fire office have passed it," and with the general public, who know nothing of the danger they run, this appears to me to be a guarantee, in their opinion, as good as a certificate from a consulting engineer superintending the work on their behalf.

Much has been written about jerry workmanship, but in my opinion jerry material is quite as much to be condemned, and the fire offices having set themselves up as "authorities" on the subject, should do the thing thoroughly, as at present their clients are in many instances resting in false security.

The fire offices would do the electrical profession a valuable service and reduce their risks if they collected together a number of specimens of electrical accessories of all classes and makes, and classify them, so that the uninitiated could go to the office of the company they are insured in and see what they should have put in their buildings, and what they should avoid.

Plenty of the public pay good prices for jerry work through ignorance, and the more the fire offices do to dissipate this the better for themselves and the better class manufacturers, who have to fight against it.

Let them start on lampholders; they will have a busy time shortly.

Walter Blenkarn.

January 18th, 1898.

THE ENGINEERS' STRIKE.

The chief anxiety of the A.S.E. this past week seems to have been that the *status quo ante bellum* should be secured. Juvenile copy-books once contained a line stating that "Time which has past will never return." There can be no return to the ante-strike period; the men cannot go on where they left off. The hours' question—that "popular" breeze to which the A.S.E. so gaily spread their summer sails, has died away into a very dead calm, only to be succeeded by the cyclone of management questions, and a veritable tornado of bottled up grievances on the points of restriction and loafing, which, though it may be marked by wreckage, will undoubtedly clear the air, and leave an open way for a different future. Now that the men are beaten, the greatest kindness that can be shown them is to see to it that future concessions have nothing of the element of weakness in them; no giving way to unreasonable demands for peace sake, and no bending before the ignorant demands of self-appointed agitators. Let Mr. Burns be followed in his cry for American methods, albeit he spoke better than he knew.

It was reported on Friday that the hours' demand had been unconditionally withdrawn. This was denied by Mr. Barnes, but it was not thought he was in a position to know. Telegrams came from Manchester and Glasgow to the effect and Mr. Barnes gave somewhat indirect denials. He was busy at his trade, however—getting out a fresh manifesto. What a charm there is in these huge words for the agitator! Half the dispute seems to have been so much mouthing of long Latinised words. Manifesto, conference, delegate, come in shoals, and help to impress the simple workman.

Anyhow, Mr. Ferguson, the Glasgow local organising delegate, made a statement as to the hours' demand being withdrawn, and he confirmed the statement publicly to a reporter. The Employers' Federation, on the other hand, do not accept a simple withdrawal of the 48 hours' demand as closing the question. They do not intend to start any men who will not toe the mark on the basis of the amended proposals of the Federation, and there can be little doubt but that the men who accept will soon find the benefit of honest effort in increased pay, and will not countenance a return to skulking methods. The active of the strikers have been probably almost to a man youngsters who have not any remembrance of the times before restriction set in. They have been brought up on restriction, and possibly before long will be astounded at their own folly in listening for a moment to the commands of such leaders as have compelled them to such exhibitions of ignorance.

The Fairfield lock-out was a great blow to the strike leaders, who did not, as formerly, at once withdraw the 75 per cent. not locked out. This was generally considered a sure sign of weakness, not to be glossed over by all the financial juggling with figures as to funds available. Mr. Barnes keeps harping on his willingness to arbitrate, on the eight hours' question, and indignantly denies the charges as to connivance at restriction. Now this is really too bad, when all the country knows that restriction has been everywhere; the shop delegate has been pushing the accursed thing in every union shop; foremen have been interfered with in their duty, and for months chance labourers and apprentices have been beating the old hands by large percentages.

Mr. Barnes is fighting in the last ditch, and demanding to exercise the right of interference. Had Mr. Barnes won the day, he would have demanded eight hours, would have restricted output still further, and most probably he would have insisted upon there being a recognised trade union official in every shop—paid by the employer, of course—to interfere at every turn. Mr. Barnes' one and only mistake in the whole quarrel has been of the sort that expects to pour a quart of ale out of a pint pot. Of course he would have failed, but he would have smashed the pot. As it is, the pot has smashed him, and he is simply making himself ridiculous by his present attitude. We may admire a man who fights because of his pluck; we may pity him for his ignorance in fighting for a bad cause, or despise him if he does not fight fair, but when a man becomes the object of ridicule he is lost.

Sir E. J. Reed writes a capital letter to the *Times*. He recalls how the late Sir Joseph Whitworth, at one of the Paris exhibitions, foretold the present conditions when pointing out how foreigners, by means of Sir Joseph's own inventions, were rendering competition keen. The danger, said he, will lie with the men, who will be a long time learning that they will have to compete with cheaper men.

Sir Edward instances numerous articles he has seen which have been made abroad which he has come across in recent visits through English workshops. Without any special sympathy with employers, he sees that trades unionism, in striking at them, really strikes at the poor working man, who is the dupe of his leaders. He sees how the workmen get as much as a hundred times in wages what the employer gains as profit. He sees thousands starving as a result of a war, of which the first shot was fired by the men in London, who were working for shorter hours than millions of their fellow countrymen, women and children are working for much barer subsistence. The naked hideousness of the struggle appeals to him as to any other open-eyed man. Yet he says the men's leaders see nothing but a vulgar contest with employers and capital, as though, we may suppose, capital were a source of evil. He has not much sympathy with employers. They should have combined long ago, and kept the unions sane and reasonable and considerate. Sir Edward, in fact, repeats what we have urged, that it is the weakness in making apparently expedient concessions has caused the frog to blow himself out. The unions have, in fact, gone altogether beyond their legitimate sphere of wholesome influence, and this has ruined them by enticing them into their domineering and arbitrary attitudes. Sir Edward concludes a thoroughly sound letter with these words:—

"I have no scheme of settlement to suggest. The unhappy employers, while facing the fire of competition, are, it seems to me, attacked from behind by the representatives of the very people for whom they are making the fight. For, if I may, I will repeat that we have to-day to fight foreign competition in many countries, over many manufactures, and in many forms, and the people whom we have first to protect are the working classes of this country. The men who are in the forefront of this battle, and who must remain there, are the employers; but they are few, and for them, in themselves, we need not be greatly solicitous. It is by them and through them, however, that the interests of the working people of this country have to be maintained, and these ought to be maintained at all costs. Is it too late to ask, or is it too much to ask, that a contest which has become as ruinous as it is unnatural may be forthwith ended and a new chance be given to our own people and our own country in the international struggle?"

Probably for this letter Sir Edward Reed will be fiercely attacked when he next contests a seat in Parliament, by the very men whose real interests he has at heart. Such is the working man of to-day.

In the meantime the Manchester shops have opened their doors to non-unionists who were prepared to accept work under conference rules, and it is also understood that unionists may be employed who have definitely left the union. Very few of the latter had done so up to Saturday last, and of course they could not be taken on as unionists while their unions still maintained the 48 hours' demand.

A trades unionist writing to a contemporary denounces the so-called new unionism, which he calls upon all solid unionists to exterminate. He denounces also so much federation of unions. But for this he considers that the London struggle would not have extended to the country. It was the federation of trades union that compelled the Employers' Federation. He calls for home rule. Let every district stand alone, and so avoid the national calamity of wide-spread strikes and equally of widespread lock-outs. But it is 25 years since the last great strike. There have been numerous smaller ones in between, but the accumulation of wrong doing and error and weakness which have brought on the present struggle has been of 25 years' growth.

Before another such period has gone by we may hope that an advanced intelligence and a better knowledge of the facts of foreign competition will prevent so suicidal a thing again taking place. That some kind of benefit is desirable is the opinion of everyone. In a letter to the *Times* Mr. Maudslay suggests what seems a likely scheme. By it every workman would have control of his own funds, and if he elected to use them for purposes of a strike he would be at liberty to withdraw them for the purpose, subject simply to the safeguard that he could not draw them by proxy, but must himself draw the money before handing it over to the agitator of strikes.

Mr. Maudslay considers that the handling of the cash in solid sovereigns would usually be sufficient to induce at least a very careful consideration of the case before handing the coin to the strike fund. At present, the workman has no control over his funds, and the actuarial basis of the A.S.E. is considered by men versed in such matters to be far from sound, as, indeed, has been shown more than once by a reduction of promised benefits. The Society, in fact, promises more than it can carry out. How it will now get along is very doubtful, and the present would be a very good time to start a men's benefit fund on some such lines as Mr. Maudslay indicates; a fund from which each member could withdraw if he chose to do so, and officered by men amenable to strict commercial law, and under the guidance of properly appointed trustees. If apart from the benefit fund the men desired to keep up a strike fund they would be at liberty so to do, but it ought to be made illegal to employ any benefit fund for strike purposes, and the law should forbid the carrying on by one executive of the two functions of benefit and strikes or disputes, and should forbid the transfer from one fund to the other of money in any shape or form, except only as the man personally withdrew the money in coin, and carried it away himself. And even this we would make a matter of some days' notice, the man to be first shown the money he is to draw in gold, and then given it so many "thinking" days afterwards, during which he would have time to consider matters before making a leap in the dark, and he could consult those at home, who have the brunt to bear when dealings commence with the pawnshop. Mr. Maudslay's letter has roused the ire of Mr. Barnes, who throws all the blame on the workmen, of whom he is simply the innocent and harmless mouthpiece. This is good.

Since writing the foregoing it is publicly announced that the eight hours' demand has been withdrawn. It was so reported last week, and the report described as a fairy tale by Mr. Barnes, and as a canard by Mr. Brown. What Mr. Burns said we know not. It is reported, however, that "for the suffering they have undergone, the men demand compensation;" but from whom is not clear. They have suffered voluntarily for 28 weeks, refused good wages, and plunged the trade of the country into a pit, and ask for compensation. Many trades union leaders admit that the sole result of the half-year's struggle has been to raise a rival power, which will make it impossible in future to dictate terms to individual employers. There is one other result—the ruin of the A.S.E., morally and financially. Union folly was never so clearly manifest as now, when the nominal *casus belli* has been formally withdrawn, war is declared still to be the order of the day, because the employers insist on being victors in respect of the true *casus belli*—the question of management. Sanguine local leaders are saying that there is no reason why the men should not at once resume their places, as though it were but the second week of last July. But it is the third week of the following January, and it is certain that the new men are not going to be sacked to suit the strikers' convenience. If the new men are discharged, we should hope the employers who do so, or even permit them to be worried away, will receive due retribution. On this point there are bound to be troubles. The bellicose unionists will do their worst to render the lives of the new men miserable, and this must not be. The employers are bound to see

to it that peace shall prevail, and that disturbers of it get the run out quickly. In the meantime large numbers of men are leaving the union, and going back to work. As we predicted early in the strike, the old hands are inclined to stick to the union for the sake of their old age benefits, and the young men, who have been the cause of the war in a large measure owing to their recklessness and a desire for a cheap summer holiday, are throwing the union over rather than face future levies. We condemned the strike as a cowardly robbery by the young men of the old men's funds, and we have proved correct. Some of the daily papers still plunge wildly in the dark as to facts. Among these the *Daily News* calls for a compromise.

What compromise can be possible that will be of the slightest value? There is but one issue, and that is summed up in the one word *output*. Are the men's "friends" still asking that there shall be restriction of output? It looks like it, or else it looks like ignorance. The whole British working man is permeated with the idea of restriction. A bricklayer does not set as many bricks in a week as he could easily set in a day without overworking himself or doing bad work. And this evil, which is eating out the heart of the country, is to be compromised. Away with such nonsense. Let the men get back to work, and show by decent honesty that we can beat any other nation if we choose to do so. Let them make up their minds to earn more money and to see that they get it.

Compulsory arbitration again is not likely to be acceptable. Arbitration so commonly ends in the granting of a part of any demand that the men would be making constant big demands in order to get a part by arbitration. This would land us in similar demands by the employers, so as to get something back again. There would be no finality. There is room for some such body as the Board of Arbitration and Conciliation of the Manufactured Iron and Steel Trades of North of England. This seems to have worked well, but has been fortunate in its men, from both sides. But compulsory arbitration or Parliamentary interference will not do. We are inclined to think that the Employers' Federation will steady matters for a time, and hope to see some suitable arrangement arrived at that will prevent future wars. The great lesson to be relearned is, however, that machinery is not of necessity an ouster of labour. If the men only learn this the end of nine-tenths of the recent troubles will have arrived. The other great cause of trouble is the question of demarcation. Nothing is to be done for this beyond the most drastic commandeering. The idea of demarcation has become absurd through being carried to absurd length. Anyone making trouble on this score ought to be severely dealt with.

ELECTRIC POWER DISTRIBUTION.

A FEW days ago the secretary (Mr. Lowe) of the Midland Electric Corporation for Power Distribution, Limited, approached Sir B. Hingley, Bart., chairman of the South Staffordshire Iron Trade, and Mr. J. B. Cochrane, chairman of the South Staffordshire Coal Trade, with the object of enlisting their sympathy, and the sympathy of manufacturers generally, in the scheme of electric power distribution which the Corporation have embraced in their provisional order. As a result a meeting of manufacturers was held in Birmingham yesterday (Thursday). In his circular Mr. Lowe states:—

"The Midland Corporation is prepared to enter into agreements to supply electrical energy for power or manufacturing purposes at as low a price as 1d. per Board of Trade unit, and for lighting at the rate of 6d. per unit for the first hour's use per day and 3d. per unit for each subsequent hour's use daily. The Midland Corporation is also prepared to lay a comprehensive system of mains throughout the district, and will supply motors for hire, so that manufacturers can secure the advantages of electrical power at the minimum of capital outlay."

Here follows a comparative statement of the prices charged in 15 towns—Blackburn, Bradford, Bristol, Cardiff, Coventry, Edinburgh, Glasgow, Halifax, Leicester, Liverpool, Nottingham, Stafford, Sunderland, Walsall, Wolverhampton—in which the local authorities own and work the electric lighting orders, and which have been selected as being favourably situated for coal supply. The secretary claims that this statement demonstrates the impossibility, on account of the limited area to be supplied, of any individual local authority (of approximately similar rateable value to the towns in the area applied for) being able to sell electrical energy at anything like the figures at which the Midland Corporation will undertake to supply it.

The secretary then goes on to state that in order to carry out its objects, the Midland Corporation has served statutory notices upon, and deposited plans, with all the 18 local authorities in their proposed area of supply. The secretary adds:—

"Of these authorities, the Councils of Dudley, Walsall, and Wolverhampton already possess electric lighting orders, under which they now have the sole right to supply energy for power purposes, while the Councils of West Bromwich, Oldbury, and Smethwick are applying for similar orders in the present session of Parliament. The Midland Corporation has had no wish whatever to interfere with the lighting of these boroughs or urban districts, except with the consent of the local authority, but it submits that it is hardly within the sphere of operations which should be under municipal management to start this business of power supply; in other words, it contends that risks which are inevitable in a new enterprise of this kind, and which a company may be justified in incurring are unsuitable for a municipal authority to embark upon, having regard to the fact that they must borrow money on the ratepayers' account to enable them to do so.

"In view of the opposition to the scheme from certain of the local authorities (without whose consent it is doubtful if the provisional order can be obtained), the promoters of the order feel that the time has come when the iron and coal masters, and the manufacturers generally in the district, should be made thoroughly acquainted with the scheme, so that they may bring their influence to bear in support of the application of the Midland Corporation and assist in the introduction of electrical energy as a motive power into the district."

BUSINESS NOTICES, &c.

Board of Trade Returns.—The foreign trade returns for the past year now completed, says the *Daily News*, show less satisfactory results than were at one time anticipated. For the first six months of the year the imports showed a gain of over 4 per cent., while there was a moderate reduction of 1½ per cent. in the exports. Owing chiefly to the effects of the increased American tariff, and of the strike in the engineering trade, the decrease in the exports for the year has reached £5,795,000, or 2½ per cent., while the increase in the imports is £9,429,000, or 2 per cent. The chief proportionate reduction in exports is under the head of machinery and mill work. Steam engines show a decrease of £124,000, and other descriptions £298,000. Among metals there were increases of £75,000 in copper, £53,000 in telegraph wires, and £33,000 in iron.

Business Announcement.—Mr. A. Alan Jenkins has joined Messrs. Lloyd & Read as a partner. The firm, now known as Lloyd, Read & Jenkins, has removed from 63, Broad Street, to more commodious premises at All Saints Chambers, High Street, Bristol. The lighting of the Bristol Commercial Rooms, and the new sanitary offices, Queen Square, has just been carried out by this firm.

Catalogues, &c.—Messrs. Bergtheil & Young, of 12, Camomile Street, E.C., who are the sole agents for the United Kingdom for the Bullock Electric Manufacturing Company, of Cincinnati, have sent us lists of that company's manufactures. The lists illustrate and particularise direct current dynamos of various types for belt and direct connection, and some detailed notes are given of the principal features of their method of winding armatures. There are also several photographs of printing presses of different makes, with their direct connected slow speed motors, and views are shown of motors connected to lathes, drills, and other machine tools.

Messrs. J. D. F. Andrews & Co., of Fulham, have issued an 1898 edition of their catalogue of their systems of concentric, double, and conduit wiring. Comparative estimates are given, showing the cost per 16-C.P. lamp wired on this system and on the wood-casing method. Joints, sockets, nipples, switches, fuse and switchboards, lampholders, pendants, and various other accessories for use with the system are described and priced.

A folding list with stiff green covers has been sent out by Messrs. Veritys Limited, describing the "Standard" main switchboards. There are several different types shown:—(*a*) for plain dynamo boards; (*b*) for extended dynamo boards; (*c*) for multiple dynamo boards; (*d*) for plain accumulator boards; (*e*) for extended ditto. There are also types of main distributing boards. The list is very nicely printed and is conveniently arranged.

Messrs. Cutting Bros., of Derby, are sending out a wall card, giving a useful discount table from 2½ to 50 per cent.

The Edison & Swan United Company's Section VI. catalogue, dealing with fancy fittings, electroliers, brackets, &c., has been issued. It is dated January, 1898, so is right up to date. The list, which, like all Ediswan catalogues, is nicely laid out and fully illustrated, shows many designs of plain and fancy brackets, some of which are very artistic. This remark also applies to a variety of fancy table and floor standards, ceiling fittings, pendants and electroliers. Special bronze and Doulton ware figures and elaborate candelabra are also illustrated.

Canada as a Mica Producing Country.—Since the application of mica for electrical purposes, the production during recent years has assumed considerable importance, and on account of its abundant occurrence in excellent quality in Canada the attention of capitalists has been attracted to mica properties in the dominion. Canada has long been known to be rich in economic mica deposits. More than 30 years ago, Sir William Logan ("Geology of Canada," 1863, pp. 494-5 and 795) referred to the deposits of "Muscovite" or "white" mica, then known to exist on Yeo's Island, Cape Tourmente and other sections of Quebec. Mention is also made of the phlogopites or "amber" mica at Grenville, Quebec, and in North and South Burgess, Ontario. "In all of which," says Sir William, "the mica is obtained in large sheets, which being transparent and free from flaws, are wrought and employed for the same purposes as the 'Muscovite' or potash varieties." An early producer was the Sydenham property in the Kingston district, and an important deposit of "Muscovite," particularly referred to by Dr. Selwyn, director of the Geological Survey of Canada, in the Report of the Royal Commission on the mineral resources of Ontario, has been opened at Villeneuve, in Ottawa County, while at Templeton, about 16 miles from the city of Ottawa, several extensive deposits of first-class "amber" mica, notably on the Wallingford property, have been worked. Dr. Selwyn's high opinion of the Villeneuve "Muscovite" mica is fully confirmed by another well-known Canadian expert, namely, Prof. F. Cirkel, who has also reported in high terms on the Wallingford and the Lake Gerard properties. Referring to the output of the last named, it is recorded to have been as high as 122 tons in a month.

Concert.—On Friday last a concert was given by the People's Palace Electrical Class.

Contradiction.—We are authorised to contradict that portion of the *Westminster Gazette's* statement, published in our last issue, to the effect that Messrs. Easton, Anderson & Goolden, had entered into an arrangement with Messrs. Schuckert & Co. for manufacturing electrical plant under their patents, the rumour being without foundation.

Dissolution of Partnership.—Mr. W. H. Slater, of Slater and Spurgin, electrical engineers, of Holloway Road, wishes to notify that Mr. Malcolm A. Spurgin having left the firm, he will carry on the business in his own name.

Electric Pumping.—*Daily Tenders and Contracts* says that the Harrogate Corporation has decided to work the pumps at the Sewage Farm, Ripon Road, by an electric motor in place of a gas engine.

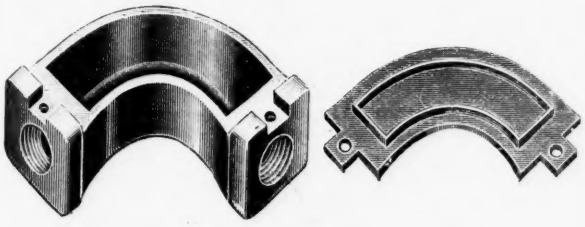
Fire.—On 13th inst. a fire broke out at Harrison's Electrical Engineering Works, Soho Street, Pemberton.

First Meetings.—The first meetings of creditors and contributors in the Ward Electrical Car Company will be held on January 26th at 11 and 11.30 a.m., at 33, Carey Street, W.C.

Gas.—A serious gas explosion occurred at the works of the English Gas Company, at Schoeneberg, Germany, on 13th inst., three persons being killed, and three severely injured.

German Enterprise in South America.—An indication of the enterprise of German firms is afforded by the formation in Berlin of the German Transmarine Electricity Company (Deutsch-Ueberseeische Elektricitats-Gesellschaft), under the auspices of the well-known Allgemiene Elektricitats Gesellschaft, the Deutsche Bank, and several other German banks. Mr. Emil Rathenau, of the Allgemeine Company, is one of the directors of the company, which has been constituted with a capital of 10,000,000 marks. The company propose to establish electrical installations of all kinds in America, and as a commencement, a lighting and power station is to be built at Buenos Ayres.

Interior Wiring.—Messrs. Newsome, Pinching & Co., of 1, Crutched Friars, E.C., are the sole agents for Russell's patent accessible bend, which we illustrate below, the drawings being self-explanatory. The bend is the device of Mr. C. N. Russell, the



electrical engineer to the Shoreditch Vestry, and it is largely used in connection with the lighting installation at the New British Gallery of Art, Grosvenor Road. The firm also makes a speciality of circular switch cases, circular four-way boxes, and Russell's straight box, all the fittings being screwed for iron gas barrel.

Kaye v. Croydon Tramways Company.—Mr. Justice Kekewich heard this case in the Chancery Division last week, it being a claim by a shareholder in the Croydon Tramways Company for an injunction to restrain the company from carrying into effect an agreement for the sale of the undertaking to the British Electric Traction Company. The injunction was granted. It appears that the principal ground for the application for the injunction was the provision under the said agreement for the payment of various sums, amounting in all to £3,250, to the directors and officers of the company for compensation for loss of their positions by the purchase.

Lazare Weiller.—Mr. Fernand Espir, the English representative of the well-known Compagnie des Etablissements Lazare Weiller, sends us a nicely framed view of the very extensive works of that company at Havre, also showing the dwellings of the workmen on the outskirts of the works.

Liquidation Notices.—A meeting of the Electrical Installation Company will be held at 135, Victoria Street, Westminster, on Friday, February 18th, at 2.30 o'clock, to receive an account of the winding up from Mr. O'Brien, the liquidator.

A meeting of the River Plate Electricity Company will be held at 78, Coleman Street, on February 23rd, for a similar purpose. Liquidators—Messrs. J. H. Duncan & T. S. Hamilton.

A meeting of the Acme and Immisch Electric Works will be held at 2, Clement's Inn, Strand, on February 4th, at 3 o'clock, to hear an account of the winding up from the liquidator.

Photographic Exhibition.—The Royal Photographic Society is organising an International Exhibition of Photographic Apparatus and Photographs, which will open at the Crystal Palace on April 27th. There will be extensive loan collections, illustrating the enormous scientific and commercial applications of photography, photographs in colours, photographs by means of the X rays, and kindred exhibits.

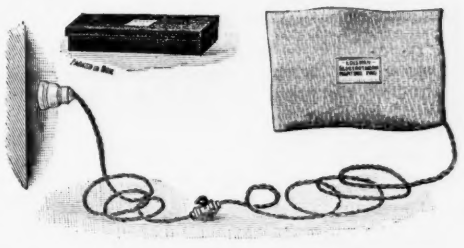
Soldering Paste.—Messrs. Beanland, Perkin & Co., of Leeds, are placing on the market Burnley's rozinal soldering paste, which is claimed to contain no acid or other substance injurious to wires or insulation. It is used for soldering armature connections, commutator bars, or field connections. By using this paste, it is claimed that wires can be soldered in half the usual time, and the finest wires can be united without oxidisation or injury to insulation.

South African Electrical Notes.—The *British and South African Export Gazette* has the following electrical items in its January issue:—Orders for various types of transformers and motors have been placed with European firms by the Rand Central Electric Works, Brakpan, Transvaal. The new electrical installation supplied to the Transvaal Gold Mining Estates was furnished by Messrs. Siemens & Halske. It is on the three-phase system and of a pressure of 3,000 volts. Part of the material for an overhead system of electrical traction for the Sheba mine has been shipped. The East London Town Council is, we understand, meditating an electric light installation. In the event of the electrical machinery for the Sheba mine not being recovered from the wreck of the *Clan Gordon*, duplicate orders for machinery will have to be placed. The second electric motor to complete the projected equipment of the Piggs Peak gold mine has been shipped. Two electric 25-H.P. locomotives have, we understand, been supplied to the Transvaal Gold Mining Estates.

South v. Lowenfeld.—This was an action heard at Westminster to recover £18 odd from the lessee of the Prince of Wales' Theatre, Coventry Street, W., balance of account for electrical work at the theatre. It was admitted that the orders were received through one Woods, the theatre electrical engineer, who was at one time also in the employ of plaintiff. On the other hand, plaintiff said that when he saw defendant at the theatre after the work was done, he said nothing about Woods not having authority to give the orders. The defence was that Woods had no authority to give plaiatiff orders. Judgment was given for the defendant.

South v. Nathan & Summers.—On Thursday last week in the Westminster County Court, the case of South *v.* Nathan and Summers came before his Honour Judge Lumley Smith, Q.C. The plaintiff, Harry South, an electrical engineer, of Garrick Street, sought to obtain payment for making an electrical outfit for a lady, "The Wonderful Lamp." The defendants, music hall agents, employed Mr. South to fit a dress for Miss Hewitt, who was performing at the Palace Theatre in 1894 with electric bells, and her head-dress consisted of coloured electric lights. A battery was included in the apparatus. The account also contained an item for repairs. The defence was that Miss Florence Hewitt was the person liable. Judgment was given for the plaintiff for the amount claimed, with costs.

The Electrotherm.—The Edison and Swan United Electric Light Company is introducing the electrotherm, a patent heating apparatus, which has on several occasions been briefly referred to in our columns. We now illustrate the pad, which is composed of wires insulated and protected by asbestos, woven into a light and flexible sheet or pad, which, when attached to the ordinary incandescent lamp socket, offers sufficient resistance to the current to produce a constant and uniform degree of heat. The value and efficiency of the electrotherm are appreciated in cases of rheumatism, neuralgia, pneumonia, and other complaints, wherever the application of artificial heat is desired. By its use the risk and discomfort of frequent changes of temperature incident to the renewal of ordinary hot applications are entirely obviated. The electrotherm



is made for any voltage from 5 to 125 volts, and can be used with either direct or alternating current. The voltage required is printed on each article. If a 200-volt pad be required, it is recommended to use a 16-C.P. Edison and Swan lamp of 100 volts in series with a 100-volt pad. If a 220-volt pad, a 110-volt lamp in series with a 110-volt pad. For general use, the size of the electhotherm is 11 × 15 inches, ¼-inch thick, provided with regulating switch, connecting plug, and 15 feet of flexible conducting cord, with coverings suited to various purposes. In a circular just issued by the company, full directions are given for use.

Utilisation of Water Power in Spain.—A proposal to put down plant to utilise water power in the Iguna Valley, in Santander province, in the generation of electrical energy, is at present under consideration. It is stated that 1,000 H.P. is available.

ELECTRIC LIGHTING NOTES.

Aberdeen.—The committee has agreed to consult Prof. Kennedy with regard to the proposals contained in the report by Mr. Blackman and Mr. Smith *re* proposed extensions before proceeding further in the matter.

Acton.—Mr. James de Lara Cohen does not propose to proceed further at present with his application to the Board of Trade for a provisional order giving power to light his estate at Friar's Place by electricity.

Alfreton.—An electric supply company has written to the District Council asking for consent to its proposal to supply the town with the electric light. The letter will lie on the table for six months.

Asylum Lighting.—The directors of the West Green Asylum, have, according to a Dundee paper, given a contract to the E.P.S. Company for maintaining the storage batteries at West Green and Gray House. The electrical plant at the asylum is now so far completed as to enable a 24 hours supply to be kept up.

Ayr.—The Burgh electrical engineer reports that for the month of December, through the heavy load of Christmas and New Year week, all demands for current were met. The machinery was overloaded but there was no trouble. The Commissioners will borrow—subject to the approval of the Secretary of State for Scotland—£2,000 for the purpose of wiring houses for the electric light on terms "similar to those of the London Electric Supply Corporation."

Balerno.—This Scottish village is now lighted by means of five arc lamps in the main roads. The Parish Council gave the contract to Messrs. Lowdon Bros., of Dundee, and current is taken from the Balerno Bank paper mills.

Bethnal Green.—The new infirmary is to be electrically lighted. At a recent meeting of the board it was stated that the architect's report on gas and electric lighting showed an expected saving of about £240 per annum by using electricity. Inquiries are also to be made as to whether the laundry machines shall be driven electrically.

Bexhill.—A Local Government Board inquiry was held on 12th inst. into the application of the District Council for a loan of £20,000 for electric lighting. The scheme was explained at considerable length. The plant would provide for 5,500 8-C.P. lamps for private use, as well as current for public lighting. There was some opposition.

Boston.—The Council has unanimously passed a resolution in favour of electricity. A scheme before the meeting was estimated at £20,000. The yearly expenditure was given at £800, as compared with £956 now paid for gas.

Bromley (Kent).—A correspondent says that considerable dissatisfaction exists amongst the members of the Bromley Urban District Council as to the transfer of the provisional order for lighting the town with electricity. It appears that the Council entered into a provisional agreement with a company called the Bromley Electric Lighting Power Company, and undertook to hand over the powers obtained under their provisional order for a specific sum of money, but as some doubt existed in the minds of the councillors as to who were the directors of the company, the Council have communicated with the Board of Trade, and the reply has been received that the present directors of the Bromley (Kent) Electric Light and Power Company, Limited, are Messrs. Medhurst and Taylor, both of High Street, Bromley, and Mr. Gripper, an electrician, of Twickenham, who have expressed their willingness to take £5,400 worth of capital, and other capital will be offered to the residents of Bromley as soon as shares are issued.

Burton-on-Trent.—At the last Council meeting the question of the recent failure of the electric light was discussed. It was shown that it was due to the breaking down of the India-rubber insulation.

Calcutta.—An Indian exchange says that very little has been done yet in regard to commencing work on the electric supply for Calcutta, which a local firm is to carry out on behalf of a syndicate. A committee has been appointed to settle matters in regard to overhead lines, and until this question has been gone into, progress will be purposely retarded, as much depends upon the acceptance of the company's proposals for the laying of mains in the several streets.

Chelsea.—The standing orders have been found to be complied with in the case of the Chelsea Electricity Supply Bill, which came before the examiners this week.

Colwyn Bay.—The Surveyor (Mr. W. Jones) has produced plans showing the two routes for the line of cables for electric lighting of the Promenade. The cable is to be laid along Lawson Road to the Parade.

Crieff.—A letter from Mr. R. Frederick Yorke was read at the last meeting of the Town Council, in which that gentleman puts forward a scheme for utilising water power for electric lighting, which he recommends instead of the steam scheme already under the Council's consideration.

Cromer.—The *Eastern Daily Press* says that the Highways Committee has received a letter from Mr. Gibbons, (?) Town Hall, Bradford, asking if the Council had any intention of transferring their provisional order for electric lighting to a company, and stating that if such was the case he would be able to submit an offer. The Council will consider a *bonâ fide* proposal.

Croydon.—Prof. Kennedy has been appointed consulting engineer to the Croydon Corporation from March 25th next at a salary of £100 per annum, with commission on certain work. Mr. Minshall, the present engineer-in-charge, has been appointed electrical engineer as from March 25th next, at a salary of £250 per annum, rising on September 29th to £300 per annum.

Enfield.—The General Purposes Committee is inclined to oppose the granting of electric lighting powers to the gas company, but has asked for the company's observations first.

Glossop.—A sub-committee of the Town Council is to see the manager of the Municipal Electric Supply Company *re* the electric lighting proposals put forward by that company. The question of putting down a municipal plant is not being lost sight of.

Gourock.—The Burgh Commissioners will oppose the application made by the North British Electricity Company for a provisional order.

Greenock.—The Electricity Supply Company, which proposed to apply to the Board of Trade for a provisional order to supply electricity in Greenock, does not intend to proceed with the application at present.

Hereford.—The County Surveyor has been looking into the question of lighting the Assembly Rooms by electricity, and has prepared estimates of the cost of plant, &c., but as a provisional order is now being applied for, nothing will be done in the meantime.

Hull.—A proposal to instruct the Works Committee to consider the advisability of lighting the Workhouse premises by electricity throughout came before the Board of Guardians, but there was opposition, and the proposal was negatived by a large majority, as the Committee "already had sufficient to do."

The tradespeople are asking for a reduction in electricity charges.

Ipswich.—A London electrical firm has approached some members of the Lighting Committee with a view to securing a transference to them of the Council's provisional order.

Ipswich (Queensland).—The Australian *Building, Engineering, and Mining Journal* recently gave the following list of the tenders submitted to the municipality for the supply of electric lighting plant and machinery, &c. Notice of the invitation of tenders appeared in the REVIEW:—

		£
SECTION A.—	Crompton & Co.	1,020
	Siemens Bros. & Co., Ltd.	1,075
	Babcock & Wilcox, Ltd.	1,650
SECTION B.—	Crompton & Co.	856
	Siemens Bros. & Co., Ltd.	971
	Babcock & Wilcox, Ltd.	1,050
SECTION C.—	Siemens Bros. & Co., Ltd.	3,159
	Brush Electrical Engineering Co., Ltd.	3,200
	Babcock & Wilcox, Ltd.	3,550
SECTION D.—	Babcock & Wilcox, Ltd.	375
	Electric Construction Co.	417
	Siemens Bros. & Co., Ltd.	518
SECTION E.—	Siemens Bros. & Co., Ltd.	6,894
	Noyes Bros., Agents for the Callender Co.	7,316
	Brisbane Electric Supply Co.	10,068
SECTION F.—	Siemens Bros. & Co., Ltd.	725
	Crompton & Co.	760
	Nalder	785

Mr. Hesketh, the Government electrical engineer, who advised regarding the contracts, made the following notes: *Section A.*—The boiler I would prefer to have accepted would be the Babcock and Wilcox water-tube, but as the price seems too high I think the compound Cornish made by Messrs. Evans, Anderson and Phelan should be accepted. *Section B.*—If the Cornish boilers are obtained the steam pipes should also be ordered from them to save trouble. *Section C.*—Messrs. Siemens Bros.' combination I consider the best. *Section D.*—It is advisable to place the order for the switchboard with the successful tenderers for Section C. if the price is not prohibitive. I therefore recommend Messrs. Siemens' tender for acceptance. *Section E.*—I have personally great faith in the B. E. S. Co. cable, manufactured by the British Insulated Wire Co., and from personal experience can testify to its excellence. I have no reason, however, to doubt the excellence of the cable manufactured by the other two tenderers, and their prices are considerably lower. *Section F.*—The transformers quoted are all good, and in the final selection it will be on details that the decision must rest.

Jersey.—The *Times* says that the St. Helen's (Jersey) Parish Assembly on Tuesday adopted, practically unanimously, a petition to the States of the island in favour of a Bill empowering the municipality to borrow £30,000 for an installation of electric light under the direction of parochial committees.

Leominster.—The matter of electric lighting is said to be among the subjects coming before the Town Council shortly.

Liverpool.—The Liverpool Corporation is raising a million-and-a-half loan. That sum includes £600,000 paid for the tramways, £50,000 for the experimental electric tramway, and £400,000 raised under the Electric Supply Act, 1896.

London.—On Thursday evening last week, Mr. Robert Hammond read a paper on "Electric Lighting" to the members of the City of London Tradesmen's Club, at the Albion Hotel, Ludgate Circus. A great many surveyors and engineers of local Vestries in the Metropolis were specially invited to take part in the discussion which followed. Mr. Hammond, in the course of an exhaustive paper, dealt particularly with the present electric lighting monopoly in the City, observing that the company now providing the electric light charged the maximum rate, viz., 8d. per unit, whilst at St. Pancras the charge was only 5½d., at St. James' 5½d., and at Kensington 5¾d. He also said that the City company maintained a strict secrecy as to the number of units they supplied, in spite of the fact that by the Act of Parliament they were compelled to furnish an annual statement. From computations he had made, however, by means of the division of the revenue of the company by 8d. he found that the company had supplied during 1896 a total of 5½ million units. Now comparing that output with some of the other companies in the Metropolis, he thought the charge made by the City company was very unfair, because he found that companies with as small an output as 100,000 units only charged about 6d. The City Commissioners of Sewers were responsible for granting the present monopoly of City electric lighting, and the present arrangement was that until the company reached a 10 per cent. dividend, and cleared off the arrears of previous years, the consumers would have to continue paying 8d. per unit. The City company, he added, had quite recently issued £200,000 more ordinary shares, bringing the total of such shares to £600,000, and in consequence £60,000 a year had to be disbursed to the ordinary shareholders in dividends before the price could be reduced. In 1896 he found the profits of the year's working amounted to £67,000, out of which the ordinary shares ranked for a 7 per cent. dividend. The electric light company, he said, which supplied electric light to the Smithfield market area proposed to charge only 4d. per unit to the large consumers, and the smaller consumers 6d. In conclusion, he strongly urged the City authorities and other local bodies to put down their own electric lighting plant, and pointed out that it was possible to borrow money to attain that object at from 3 to 3½ per cent. with the repayments spread over a long term of years. A gentleman pointed out that the City street lamps were supplied at a charge of only 3d. per unit, but Mr. Hammond replied that these were arc lamps running all night, and did not require the same number of men to keep the work going. Mr. A. C. Morton, a member of the Corporation, said that the Court of Common Council had the matter before the Lighting Committee, and that he hoped before long to see an installation beneath the Guildhall, when the Corporation would compete with the present company, and supply electric light to all the large public buildings and other premises. The Corporation claimed the control of the streets within the City. An animated discussion followed, and eventually the matter was adjourned for further discussion at an early date. Mr. Hammond was cordially thanked for his paper.

The County of London and Brush Company is applying to the Board of Trade for power to change its supply of electricity from continuous to alternating currents, and recently applied to the St. George's (Southwark) Vestry for approval to that course, stating that the public would receive advantage from the change. A special committee is considering the matter.

Madrid.—A Madrid correspondent informs us that about the beginning of the present month the greater part of the district supplied by the Electricity Supply Company for Spain, Limited, was without light for 48 hours.

Margate.—The Corporation has arranged a special meeting for Tuesday, the 25th, to consider the advisability of opposing the application of the Isle of Thanet Gas Company for Parliamentary powers to supply electricity for the lighting of the town.

Motherwell.—The new shops of the Motherwell Bridge Company, Limited, at North Motherwell Farm, will have a complete system of electric driving and lighting. At the Dalnell Steel and Iron Works of Messrs. D. Colville & Sons, Limited, an electric power installation is in progress. A beginning has been made with a 100-H.P. unit, which will be used for driving the machinery, cranes, &c., of their new machine shop. This will be followed later on by two units of 500-H.P. each, which will provide current to drive all the auxiliary machinery in the mills, such as live roller gear, guillotines, plate shears, straightening machines, &c. The low-tension polyphase alternating current has been adopted, and it is expected that when the numerous small engines scattered about the works have been replaced by motors, a very large saving in fuel and cost of upkeep will result. Messrs. Selby Bigge & Co., Newcastle-on-Tyne, are the electricians for the work.

Newport.—The Corporation has decided to increase the salary of Mr. Copland, the engineer at the electricity works, and that of Mr. Taylor, the assistant engineer.

Oldham.—The estimated income and expenditure in connection with the supply of electricity for the year ending March 25th, 1898, shows an expected net profit of £1,600. The charges to consumers are to be reduced from that date.

Plymouth.—The Electric Light Committee has accepted a tender for the construction of the electricity station buildings.

Portsmouth.—At the Town Council last week the Finance Committee submitted a scale of charges and apparatus for testing electric light meters by the Corporation inspector. It was stated that all the meters would be tested before being issued to consumers. If, on a subsequent test, a meter was found to be incorrect against the consumer, the Corporation would pay the fee. If, on the other hand, the meter was correct, the consumer would have to bear the expense. The fee for removing the meter for testing was put at 5s. It was objected that the proposed fee was rather prohibitive, and it was pointed out that the Gas Company charged only a shilling for removing meters. Alderman G. Ellis, Chairman of the Electric Lighting Committee, remarked that the testing of the meters was a costly operation, and the fee suggested was based on the charges in other towns. The recommendation was referred back.

It is anticipated that the new machinery will soon be in working order. It is estimated that the engineering strike has cost the Committee fully £2,500 up to the present time, through loss of revenue, owing to being unable to carry out orders received, and to the payment of £300 to the sinking fund for money the loan of which has been sanctioned, but which it has up to now been impossible to employ. Despite this drawback, 456 new customers have been attached since Christmas, and 235 are waiting to be connected with the mains.

Reading.—The contract for supplying the handsome electroliers and other fittings, including the wiring of the Large Town Hall, Small Town Hall, Art Gallery, Museum, Public Library and Municipal Offices, comprising in all an equivalent of 2,500 8-C.P. lamps, was placed in the hands of Mr. Leo Sunderland, 39, Victoria Street, S.W., agent to the Brush Company. The current was switched on a short time ago, and the difference in the lighting arrangements have been much appreciated. This makes a good addition to the Reading Company's consumers.

Ripley.—An application from the General Power Distributing Company to provide an electricity generating station at Ripley, is to be opposed by the District Council.

Sheffield.—Last week, the recommendations of a committee—which we printed last week—*re* the proposal to purchase the undertaking of the Sheffield Electric Light and Power Company at the price offered by the company—namely, £220 of Corporation 2½ per cent. stock for every £100 of capital actually spent by the company, came before the Council. Several members spoke in favour of acquiring the undertaking at once, and the report was unanimously adopted. The final call of £1 per share has been made by the company, payment to be made by the end of the month. At this time the whole of the original capital of the company will be fully paid.

Smethwick.—The District Council will not consent to the Midland Electric Corporation for Power Distribution, Limited, making application for a provisional order to supply electric light to Smethwick, as that body is already applying for a provisional order for municipal plant.

Somerset.—Owing to the recent fire at the works of Messrs. T. H. Smith & Co., Ltd., situated on the River Parret, Somerset, Messrs. Massingham & Co., of this city, have received instructions to fit the entire building with a complete installation of the electric light. There will be two dynamos, one driven by water power and the other by steam.

Southampton.—At last week's Council meeting, the Electric Lighting Committee reported that the output for November was 24,240 units, being an increase of 8,970 units, or 58 per cent. over that of November, 1896. Owing to the general increase of output it has now become necessary to run the works continuously throughout the 24 hours. To do this the staff will have to be increased sufficiently to enable three eight hours' shifts to be worked. At present the only addition necessary is a third assistant engineer. The load on December 23rd was the heaviest on record, and required the whole of the plant to deal with it. In consideration of the extra work the engineers have performed since March last, a bonus of £10 is to be paid to Mr. Lee, and £5 each to Mr. Neame and Mr. Britton. The following tenders for the wiring and fitting for electric light at the electricity supply station were received:—Mr. H. M. Ashton, £387 18s. 6d.; Messrs. A. Fort, Lloyd & Co., £395; Messrs. Sanby and Co., £415; Mr. F. Shalders, £476. The tender of Mr. H. M. Ashton was accepted.

The Corporation want an assistant electrical engineer. See our "Official Notices."

Taunton.—The Electric Light Committee has been advertising for tenders for the supply of 1,500 tons of coal. During the month of December 99 16-C.P. lamps were installed; in November there were 52; and in October, 34. A scheme for a large extension is to come before the Council directly.

Wakefield.—Complaints are numerous in consequence of the non-completion of the electricity undertaking, the delay being due to the non-delivery of engines.

Walsall.—The Council will not agree to the proposed provisional order of the Midland Electric Corporation for Power Distribution, Limited, to supply electricity in the borough.

Wandsworth.—The lighting of the large and scattered premises known as the "Ram Brewery," was entrusted to Mr. Leo Sunderland, agent to the Brush Company. This is probably the largest installation of the kind in the district, comprising an equivalent of 750 8-C.P. lamps, and seven arc lamps. This installation will shortly be connected to the supply company's mains.

Water Power.—The famous falls of the Devon and grounds of Rumbling Bridge have, says the *Glasgow Herald*, been examined by electrical engineers with the object of utilising the water power to light the grounds and hotel by electricity. The engineers will be unable to proceed with the work till they ascertain the lowest summer level of the river. Should the scheme then be found practicable it is proposed to carry the water a short distance below the "Devil's Mill" in a two-feet pipe with a fall of 12 feet, which will give sufficient power to drive a dynamo to light the grounds, hotel, conservatory, stables, and outhouses.

Whickham.—A Committee has recommended the lighting of the Marley Hall district with electricity, 32 lamps being used. The price for the complete installation is £165, and the yearly charge of £55 4s.

Withington.—The proposal of the Manchester Corporation to supply this district with electric light has been considered by the Parliamentary Committee of the Withington Council, which recommends that an electrical expert be engaged to advise on the point. This recommendation has been sent back for reconsideration.

Wolverhampton.—It has been found, says our local correspondent, that the electricity turned out on Christmas Eve exceeded by 34 per cent. that turned out on the corresponding day of 1896. There is, of course, always a good demand at Christmas time, and it is reckoned at the head office that more customers are obtained at the Christmas quarter than during any other period of the year. It is now regarded as certain that the time cannot be far distant when the light will be extended over the entire borough. The new sub-station at Chapel Ash is rapidly approaching completion, and in a week or two's time it will be in working order. The mains will then be carried down the Tettenhall, Compton and Merridale Roads, where there are a large number of residential dwellings. An additional boiler is about to be put in at the Commercial Road works, and another new engine is shortly to be placed there.

The Town Council has resolved, by a majority of 25 to 8, to oppose the application of the Midland Electric Corporation for Power Distribution, Limited, for a provisional order empowering them to supply electricity within the borough of Wolverhampton.

Yarmouth.—During December the electric light receipts were £605 15s., and the expenditure £235 8s. 11d., leaving a surplus of £370 6s. 1d. to meet capital charges of £190 per month. There are now 255 customers with 11,938 lamps.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Burslem.—The Council is giving notice to the British Electric Traction Company that proceedings will be taken against them if Scotia Road is not completed and opened for traffic within 21 days; and notice is to be given to the North Staffordshire Tramways Company, pursuant to their agreement with the Corporation, calling upon them to commence the electric equipment of their line within three months, or in default their agreement would be cancelled.

Chesterfield.—The Highways and Tramways Committee is considering the question of continuing the tramways to Whittington Moor and other parts of the district; also the matter of mechanical traction.

Dover Harbour Works.—It it stated in a Dover paper that there is likely to be a start made in March with the National Harbour Works, and it is understood that electricity is likely to be the motive power employed, current in all probability being taken from the Dover Electricity Company.

Dover Trams.—The *Dover Standard* is responsible for the statement that with the Maxton section of the electric tramways now running, the amount of current being taken from the company is not likely to exceed the minimum arranged under the contract at the commencement of the running. The current required for the extra cars and quicker service is included in this estimate.

Dublin.—The Kingston Commissioners have discussed the proposed alteration in the electric tramway line through Upper and Lower George's Streets. A resolution, detailing an interlacing system between St. Michael's Hospital and the People's Park has been agreed to.

Dudley.—Mr. Reginald P. Wilson has been instructed to report to the Dudley Corporation as to the cost of buying the existing tramway to Hart's Hill; and also to furnish estimates as to the cost of equipping this and other proposed tram lines on an electrical system.

Ealing.—There is quite a lengthy correspondence in the *Middlesex County Times* respecting the London United Tramways Company's proposed electric tramway scheme, which the District Council has opposed so strenuously. Many of the writers are greatly surprised at the action of the Council.

Electric Traction on the Continent.—The *Financier* says that a powerful French company has addressed a simultaneous request to the Governments of France, Belgium, and Holland, for powers to establish a system of electric traction along the navigable highways of the three countries, so as to form an international network extending from the Rhine, through Holland, and as far as Marseilles through the Eastern departments of France, making use, for the purpose, of the navigable highways of the three countries. It is stated that the "Banque de Paris et des Pays Bas" is interested in the enterprise.

Electric Transmission of Power.—A meeting of the members of the South Staffordshire Institute of Iron and Steel Works' Managers was held on Saturday at the Dudley Institute, when a paper on "The Application of Electricity to the Transmission of Power" was read by Mr. H. W. Ravenshaw. The writer pointed out that managers of works and manufacturers generally were beginning to realise the fact that the old methods of transmission of power to their machinery were in many cases extremely wasteful, and that the electric motor is far cheaper in the end than the line shafting and isolated steam engines which have been generally employed. In an engineering works, mill, or colliery, immense quantities of coal are uselessly consumed in wearing out belts and bearings, and in raising steam which is to be condensed in long lines of pipes and perhaps re-evaporated in the cylinders without any useful purpose. In order to reduce these losses as far as possible electricity is being employed in many cases with great success, a central station being established in the works, and electric motors being employed to drive the machinery. With this arrangement the boilers could be concentrated, high pressure could be safely used, and the labour and coal consumption reduced to a minimum; short steam-pipes carried the steam to economical engines which drive dynamos, supplying the necessary light and power to the works. In America and on the Continent multipolar dynamos are generally used, but in England up to the present the simple two-pole machine has been usually employed. The question of pressure to be employed was an important one. In collieries 500 volts are frequently employed, and with this pressure several hundreds of horse-power could be transmitted without difficulty over a radius of at least one mile. In a works covering a comparatively small area, both lighting and power could be obtained from a 200-volt circuit with economy, incandescent lamps being now made to work up to 220 volts. A good many works and mills have been fitted for 100 volts, but there is no advantage in so low a pressure, while with 200 volts a very great saving is made in the cost of cables.

Electrical Power Distribution.—The members of the South Staffordshire Iron and Coal Masters' Association were to attend a meeting at the Queen's Hotel, Birmingham, yesterday, to hear from representatives of the Midland Electric Corporation an explanation of their scheme for supplying electrical energy for power and manufacturing purposes throughout South Staffordshire. Sir Benjamin Hingley, Bart. (chairman of the South Staffordshire Iron Trade), and Mr. C. B. Cochrane (chairman of the South Staffordshire Coal Trade), in issuing the invitations, express the feeling that the introduction of electrical energy into the district on a scale and for the purposes proposed should not only assist the trades now being carried on, but should be a powerful incentive to new trades to settle in the district, and thus increase its prosperity and rateable value. The Midland Corporation is prepared to enter into agreements to supply electrical energy for power or manufacturing purposes at 1d. per Board of Trade unit, and for lighting at the rate of 6d per unit for the first hour's use per day and 3d. per unit for each subsequent hour's use daily. The Corporation is also prepared to lay a comprehensive system of mains throughout the district, and to supply motors for hire, so that manufacturers can secure the advantages of electrical power at the minimum of capital outlay.

The Coseley District Council has resolved to give consent to the application of the Midland Electric Corporation for Power Distribution to the Board of Trade for a provisional order to supply the district.

Electrically-Driven Laundry Machinery.—Electric motors are employed at Alnwick Castle for the Duke of Northumberland for driving a large size washing machine, wringer, centrifugal dryer.

Light Railways.—The promoters of the Llanfair-Beaumaris light railway attended a meeting of the Menai Bridge District Council, and gave details of the scheme, the proposed speed and width of road. The line is estimated to cost £48,000. The Council will support the scheme.

The Essex County Council have passed a resolution strongly in favour of the construction of a light railway for Ongar, Dunmow, and Yeldham. The proposed line will be 27 miles in length, and will serve a purely agricultural district which is greatly in need of railway facilities.

Leeds.—A sub-committee of the Highways Committee is going to visit Glasgow *re* tramways.

Leith.—The Town Council has confirmed the proposal to purchase the tramways for £75,000.

Liverpool.—In connection with the purchase of the tramways by the Corporation, a proposal was before that body for the payment of £9,000 compensation to the solicitors of the tramways company for loss of net profits, and £1,200 to the auditors for ditto, through the transference. The proposition was not carried, the voting being 35 in favour of an amendment, and 11 against.

Last week there was a conference of the Lighting Committee and the Tramway Committee with regard to the utilisation of electricity as the motive power on the tramways, the lighting of the tramcars on the experimental line, and the extension of the electric mains throughout the city. A report was presented by Mr. Holmes, the electrical engineer, showing how the electric system could be applied to the tramway service, and the advantage that would probably result

therefrom. The proposals included the establishment of a large new electric generating station near the Leeds and Liverpool canal, the outlay being £150,000. It was decided to refer the matter to Dr. Hopkinson.

Manchester.—It was stated last week that the Manchester Carriage and Tramways Company was inviting representatives from the various local representatives around Manchester to attend a conference on the subject of their proposed Bill for using electrical and mechanical power in connection with their tramways.

Middlesbrough.—A Middlesbrough paper in a recent issue mentions the marked progress that is being made with the preparation of the track for the electric tramways. Mr. Robert Smith, who had charge of the Dublin and Bristol construction work for the Imperial Tramways Company, is in charge here. The section between the Borough Hotel and the Ormesby Toll Bar, a distance of a quarter of a mile, was laid within eight hours, reckoning from the time of breaking up the roadway to getting in the setts.

Mines Drainage by Electrical Pumping.—Mr. J. B. Cochrane presided at the usual monthly meeting of the South Staffordshire Mines Drainage Commission on 5th inst., at Dudley, and in moving the adoption of the engineer's reports, said he understood that the Midland Electrical Power Company were seeking powers to supply electricity all through the district. They would undertake to supply, for manufacturing purposes, electricity at the rate of 1d. per Board of Trade unit, which was equal to 1 3 H.P. The question had been before several local authorities in the district, who did not quite see eye-to-eye with the company. Many were opposing the powers sought for by the company, on the ground that they would like to retain the power of supply themselves. That was reasonable enough, if the authorities were prepared to supply the electricity to manufacturers at something like the same rate that the company proposed to do it. He believed the company had approached the Dudley Corporation, who, he understood, could not supply electricity at less than 2½d. per unit, as against 1d. by the company; but they would see at once that it would be useless for the Corporation to propose the supply of electric power at 2½d. when the company could do it at 1d. per unit. He believed 18 local authorities were comprised in the area which the company proposed to supply, and it was easy to understand that whilst the company would be able to put down economical plants to supply particular areas, each of the local authorities would have to put down a separate and costly plant. He took it that the local authorities had no desire to hinder the progress of manufacturers, and if they could not do it at less than 150 per cent. more than the company, then it became a question whether the authorities should not stand aside and let the company do the work. The scheme had a most important bearing upon the work of the Commission, and the scheme for unwatering the Tipton district. They would be able to pump the water from the surface at various points by electric power, and the cost would be very small indeed compared with what it cost to pump it out of the mines. It would probably save contemplated expenditure of between £30,000 and £40,000 in the Tipton district, and they could understand what an important consideration that was at a time when they scarcely knew how to go on and face the large expense of pumping a district overloaded with water.

Motor Dust Carts.—The Hackney Vestry has deferred for six months the further consideration of the proposal to consider the advisability of adopting carts and vans driven by electrical or other automatic motors.

Motor Mail-Carts.—The *City Press* says that it is stated that the chief executive officials at St. Martin's-le-Grand are so satisfied with the experimental motor-car (steam) that runs between London and Redhill that we may shortly see the introduction of a small *electric* letter mail van.

Norwich.—The Norwich tramways are not yet begun, says the *Norfolk Standard*, and we shall not be able to chronicle work in progress for another two months at least.

Portsmouth.—The Town Council last week confirmed its recent resolution authorising the promotion of a Bill in the ensuing Session in reference to the acquisition of the local tramways.

South Staffordshire.—At the last meeting of the West Bromwich Council, a letter was read from the Board of Trade, enclosing a correspondence which had taken place with the South Staffordshire Tramways Company. The latter company had applied for a further extension of time for the use of steam on the tramways, but the Board of Trade express regret that the arrangements for the re-equipment of the lines had not taken place, and that a new method of traction had not been completed. They would grant a further extension for a period of three months, but they warned the company they must not rely upon obtaining any further extension of time.

Southport.—The Town Council has adopted the recommendation of the Tramways Committee to make application for a provisional order enabling the Corporation to lay four miles of tram lines to Blowick, with subsidiary lines forming a connection with the line to the new infirmary, and thus providing a circular route. It was proposed to adopt overhead electric wires and single deck cars, and to greatly extend the tramway system in the future.

Suggested Electric Tramway.—A correspondent of the *Surrey Advertiser* suggests a conference between experts of the Town Councils of Guildford and Godalming and the Milford Parish Council to consider whether it might not prove profitable—as it certainly would be a convenience to the public—to establish an electric tramway between the three places, with branches extending up Sandy Lane to the immediate vicinity of Charterhouse and the building land under development thereabouts, and perhaps also to the Farncombe Station from the Portsmouth Road.

Sydney.—An Australian contemporary remarks that the generators, accumulators, &c., for the Rose Bay electric tramway are now being erected at the Rushcutter Bay Power House, Sydney. The survey has been completed. Tenders for the construction of the permanent way are being invited.

The Charing Cross, Euston, and Hampstead Railway.—The Charing Cross, Euston, and Hampstead Railway Company have deposited a Bill for powers to extend their authorised line from a point under Charing Cross Road, near the Garrick Theatre, to a point under No. 23, Craven Street, Strand. This extension is to be in substitution for the authorised Charing Cross terminus, which it is proposed to abandon. The Bill also seeks an extension of time until August, 1902, within which to construct the line as authorised in 1893, subject to the new terminus now proposed. Power is also sought to enter into agreements with the South-Eastern Railway Company and the London and North-Western Railway Company as to the working, management, and maintenance of the railway when completed.

Waterloo and City Electric Railway.—This line will shortly be opened for traffic. The line itself was completed some time ago, says the *Times*, but delay which could not be avoided has occurred both by reason of the dispute in the engineering trade, and also in connection with the enormous amount of underground work which has had to be undertaken by the Central London Railway Company at the new station opposite the Mansion House.

Whitechapel and Bow Proposed Railway.—A meeting of the London, Tilbury, and Southend Railway will be held on February 3rd to lay before the shareholders the proposed Bill for the construction of works and purchase of additional lands, also to subscribe towards the undertaking of the Whitechapel and Bow Railway Company, or to guarantee interest on the capital of that company.

TELEGRAPH AND TELEPHONE NOTES.

African Trans-Continental Telegraphs. — The *Rhodesian Times* for December 17th stated that that part of the Trans-Continental Telegraph which is now being carried up northward from Umtali towards the Zambesi, and will join the line which has already been set on the farther side of the river, will, if all goes well, be finished about April next. It is expected at Blantyre that the line northward will reach Karonga about the same time—that is, Cape Town will be in direct telegraphic communication with the northern end of Lake Nyassa, 10° south of the equator. And at the same time the southern point of the telegraph line in Egypt will be about 15° north of the equator. Thus, to complete this extraordinary work, there will only remain some 25° of latitude to be crossed, and in that distance Uganda lies midway. Mr. Rhodes' wonderful dream is becoming more and more of a tangible reality.

Australian Cable Service.—Several letters have appeared in the *Financial Times* during the past few days complaining bitterly of the inefficiency of the telegraph service between this country and Australia, which subject we have ourselves dealt with on many occasions.

Delays in Australian Telegrams.—We have again to place upon record two cases of interruption and delay in the Australian land line service. As we have pointed out on former occasions, this information is gathered from press notices, and thus, doubtless, there are many occurrences of this nature which escape our notice. Were the Postmasters of South Australia and of West Australia to act up to their duties towards the Bureau International des Telegraphés, it would spare us the doubt which we sometimes feel that we have omitted to register some of the interruptions which should be reported to the Bureau for the common convenience of all interested in telegrams. The following extract from the *Melbourne Age*, of November 20th, has only just reached us:—

"The Telegraphic Service. A Far-reaching Block. Business Paralysed.

"The telegraphic system suffered very severely by the storm, and all last night the lines were in a chaotic state. Telegraphic business from the Melbourne office was completely paralysed. It was possible to communicate with Geelong and Ballarat, and with stations on the North-Eastern line, by which Sydney is reached, but Adelaide and intermediate stations, together with other trunk lines and the Tasmanian service, were completely silenced. The central authorities, indeed, state that such disastrous results have never before accrued from any storm. The public, unfortunately, will suffer serious inconvenience from the vagaries of the wind and lightning, as the operators have before them large piles of messages ready for despatch, but are absolutely prevented by the wrecked state of the lines from sending them out. Worse still, the line repairing department is, so far, unable to estimate, even approximately, the time at which the service can be resumed. Gangs of line men have been sent out in all directions, however, and the work of repair will be pushed on with all possible speed, and the operations of the repairers will, as rapidly as possible, be extended into the remote districts where it is known bad breaks have occurred."

We also gather from the press that, on Saturday week last, "in consequence of the Australian land lines working badly," no cables reached an important firm of London brokers.

Interruption of Australian Land Lines.—In the absence of information from Berne, we have to thank the Singapore press of December 13th last for the following:—"The South Australian land lines between Port Darwin and Adelaide are interrupted by heavy floods at the Katherine, 15 inches of rain having fallen in a little over 24 hours. Everything is being done to restore communication as soon as possible. The lines *via* Roebuck Bay and Western Australia are working well."

Paisley Telephones.—The National Telephone Company has asked the Council to appoint a committee to meet representatives to consider the question of certain improvements in the telephone system, such as the placing of the twin wire or metallic return system. The matter will be considered by the whole Council in committee.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Brest-St. Pierre (Anglo, 1869)	April 6th, 1893 ...	...
West Indies—		
St. Croix-Trinidad ...	Nov. 30th, 1896 ...	...
Cape Haytien-Puerto Plata	Dec. 31st, 1897 ...	...
Curaçao-La Guayra ...	Jan. 5th, 1898 ...	...
Amazon Company's cable—		
Parintins-Itacatiara ...	May 5th, 1896 ...	...
Obidos-Parintins ...	Dec. 7th, 1896 ...	...
Para-Cameta	Jan. 13th, 1898 ...	...
Bundaberg-New Caledonia ...	Nov. 4th, 1897 ...	...
Ceara-Maranham	Dec. 23rd, 1897 ...	...
Teneriffe-St. Louis (Senegal)	Dec. 24th, 1897 ...	...
Para-Maranham	Jan. 3rd, 1898 ...	Jan. 15th, 1898
Saigon-Hong Kong	Jan. 8th, 1898 ...	...
Landlines.		
Trans-Continental line beyond Masol	March 12th, 1896 ...	...
Carthagena - Barranquilla (Columbia)	July 4th, 1896 ...	...

The Bermuda-Jamaica Cable.—The Direct West India Cable Company announces the completion of its cable from Bermuda to Turk's Island, thereby establishing telegraphic communication with the latter colony. Messages can now be accepted in Great Britain and Ireland at the rate of 3s. a word. The cable steamer is now laying the company's cable from Turk's Island to Jamaica, and it is expected to be completed well within the contract date, namely, 31st inst.

The Pacific Cable.—The *Times* of Tuesday has an article discussing the Pacific cable scheme in relation to the Colonies. It is considered that in view of the developments taking place in the Far East, the project of an all-British Pacific cable connecting the British Colonies of the North with those of the South Pacific acquires fresh importance. After dealing with the history of the proposal, the writer says:—"In the summer of last year the question again formed a subject of discussion in the conferences of Premiers held at the Colonial Office, and again no formal information was given to the public as to the result of the discussion. An informal statement was, however, made, and though unauthorised, has been since confirmed from Colonial sources in a way which leaves little doubt of its authenticity, that the position as to the construction of the cable was entirely changed by the proposal of the Eastern Extension Telegraph Company to lay an all-British line from Western Australia across the Indian Ocean to Mauritius, thence connecting with the Cape and St. Helena and Ascension. The proposal appears to have been submitted to the consideration of the Colonial Premiers as a substitute for the Pacific cable. Here, then, so far as the history of the movement can be summarised in a few words, the situation rests. As between a Pacific cable, for which they will be asked to pay, and an all-British Eastern Extension line connecting Africa with Australia, for which they will only be asked to make indirect concessions, Governments, with the fear of the Treasury before their eyes, hesitate to commit themselves to the support of the Pacific cable scheme." Dealing with the future, the writer says:—"Every sign would seem to indicate that the coming 20th century will be celebrated in the history of the world by the development of a new civilisation on the Pacific. To affirm the legitimate position of Great Britain in that civilisation must be the object of British policy, and for this purpose cheap and rapid means of communication between the local British centres is one of the first of necessary conditions. This aspect of the question is not dealt with by any proposals for cable construction that exclude the Pacific Ocean from their scope." . . . . "The estimated cost of the cable is not great, and it is difficult to comprehend that the construction can have been so long delayed." The *Daily Mail* of January 19th states, under date Montreal, January 18th, that interest in the all-British Pacific cable has been revived by events in the East, and that Sir Sandford Fleming has published an open letter to Sir Wilfrid Laurier reviewing the history of the project, and calling upon Canada to take the initiative at once.

A Cape Town despatch says that a deputation of the Afrikander Bond, headed by Mr. Hofmeyr, presented last Friday an address to Sir Alfred Milner, Governor of Cape Colony, representing the urgent necessity, in the interest of Imperial defence, of an all-British deep-sea cable. His Excellency, in reply, said he was not acquainted with the views of the Imperial Government on the subject, but he promised to forward the address to England.

The Telephone Service.—The *Daily Mail* has learned "on authority which it believes to be reliable that the Post Office has already come to a very important decision with regard to the telephone question. It hears that the Post Office inquiry into the request (for a license) that came from the city of Glasgow has resulted in an official report confirming the old attitude of refusing to grant any fresh licenses. The Post Office, it understands, takes up the position that the telephone system is on all fours with the telegraph system, that it should not be allowed to fall into local hands, for fear that systems under different regulations and possibly making different charges should be established in separate localities. The Post Office claims that, like the telegraph and penny post, the telephone system should be uniform in its charges and regulations." We are unable to obtain any confirmation of this intelligence, but since the reasons mentioned conform to those publicly advanced on behalf of the Post Office, and, moreover, agree with public policy, we should not be surprised if the information proved to be correct. But where is Sheriff Jamieson's report?

CONTRACTS OPEN AND CLOSED.

OPEN.

Ashton-under-Lyne.—February 2nd. The Baths Committee want tenders for the installation of the necessary wires and fittings for the electric lighting of the Corporation Baths. Consulting engineers, Messrs. Lacey, Clirehugh & Sillar. See our "Official Notices" last week for particulars.

Bilbao.—February 28th. The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Consul at Bilbao, reporting that the provisional board appointed in connection with the electric tramway which it is proposed to lay from Zumarraga to Zumaya, in the province of Guipuzcoa, invite plans and tenders, to be received by February 28th, for the construction and equipment of the line. Further particulars of the conditions of the tenders for the above-named tram line and branch, which together measure 30 miles, may be inspected at the Commercial Department of the Foreign Office any day between the hours of 11 and 6.

Bedford.—January 24th. The Corporation want tenders for the supply and delivery of vulcanised rubber cables. See our "Official Notices" January 7th.

Belgium.—February 11th. The Provincial Government Authorities in Brussels are inviting tenders for an installation of electric lighting in the offices of the Governor of Brabant in the Rue de Chêne, Brussels. Tenders to be sent to the Gouvernement Provincial, Brussels.

Berlin.—March 15th. The Municipal Traffic Deputation of the Town Council have opened a competition for the construction of several new electric tramways in that city. Exhaustive details concerning this project are contained in the *Elektrotechnische Zeitschrift* of the 13th inst., which mentions that proposals will be received by the Stadtische Verkehrsdeputation Rathhaus III, Berlin, by March 15th.

Blackburn.—January 22nd. The Corporation want tenders for a 500-kw. continuous current steam dynamo, and a 120-kw. steam alternator. Consulting engineer, Mr. E. M. Lacey. See our "Official Notices" January 7th.

Bradford.—February 1st. The Corporation is inviting tenders for the electrical equipment of about nine miles of street tramways. There are three contracts for the following sections:—(1) steel poles, bracket arms, &c.; (2) trolley wire, insulators and overhead equipment; (3) cars, trucks, motors and trolley poles. Particulars from the city surveyor or the city electrical engineer at the Town Hall.

Brighton.—January 31st. The Town Council want tenders for dynamos, motors, switchboards and wiring for the electric lighting of the Municipal School of Science and Technology. Specifications from the town clerk's office.

France.—January 22nd. The Municipal Authorities of Neuilly-sur-Seine are inviting tenders for the concession for the establishment and working of a central electric station in the town. Particulars from, and tenders to, La Mairie de Neuilly-sur Seine.

France.—March 31st. Tenders are being invited by the Municipal Authorities of Saint Chamond (Loire) for the concession for the lighting of the public streets of the town, either by gas or electricity. Particulars from, and tenders to be sent to, La Mairie de Saint Chamond (Loire).

Germany.—January 29th. The Hanover Direction of the Prussian State Railways is inviting tenders until the 29th inst. for the supply of 39,000 porcelain insulators, 1,000 screw supports, 300 tons of galvanised wire and about 2½ tons of insulated wire. Particulars from, and tenders to, Die Königliche Eisenbahn Direction, Hanover.

Leicester.—January 31st. The Leicester Corporation invites designs and tender for motor vehicles for the collection of house refuse. Specifications and particulars, with drawings, to be sent to the Chairman of the Sanitary Committee, to the office of Mr. E. Geo. Mawbey, C.E., borough engineer, Town Hall, Leicester.

Newport.—January 24th. The Electricity Committee want tenders for the supply and erection of mains, transformers, switch gear, cast-iron posts and for arc lamps. Consulting engineer, Mr. Robert Hammond. See our "Official Notices" January 7th.

Newport.—January 25th. The Corporation want tenders for temporary electric lighting plant for the Wentwood Waterworks, for arc and incandescent lighting. See our "Official Notices" January 14th.

Rochdale.—February 19th. The Corporation want tenders for steam dynamos, balancer, and boosters, &c. Engineers, Messrs. Lacey, Clirehugh & Sillar. See our "Official Notices" January 14th.

Roumania.—March 15th. Tenders are being invited by the General Direction of the Roumanian Post and Telegraphs in Bucharest for the supply of 56,000 metres of galvanised iron and steel wire.

Spain.—February 1st. Tenders are being invited by the Municipal Authorities of Tarifa (Cadiz province) for the 20 years' concession for the lighting of the public streets of the town by electricity, acetylene or gas. Tenders to El Secretario del Ayuntamiento de Tarifa (Cadiz) from whom particulars may be obtained.

Spain.—February 8th. Tenders are being invited until February 8th by the Municipal Authorities of Tordesillas, a small town in the province of Valladolid, for the concession for the electric lighting of the public streets during a period of 20 years. Particulars may be obtained from, and tenders should be sent to, El Secretario del Ayuntamiento de Tordesillas (Valladolid).

Stockport.—January 27th. The Corporation is wanting tenders for various plant and machinery for electricity supply works at Millgate, Stockport, including Lancashire boilers, steam dynamos, feed water heater, storage battery, electrical instruments, electrical connections, wiring, &c., at the generating stations, underground cables. Electrical engineer, Mr. James N. Shoolbred, 47, Victoria Street, S.W. See our "Official Notices" January 14th.

Wimbledon.—February 2nd. The District Council wants tenders for the supply, delivery and erection of water tube boilers, condensing plant, overhead crane, high speed steam engine and alternator, switchboard, underground mains, conduits, &c. Consulting engineer, Mr. A. H. Preece. See our "Official Notices" January 14th for particulars.

CLOSED.

Barrow.—The minutes of the Electric Lighting Committee, which were adopted by the Council the week before last, contained recommendations to accept the following tenders, which had been reported upon by Mr. Manville, for the electricity supply undertaking:—

Buildings.—W. W. Fairbairn	£3,386
Section A.—Babcock & Wilcox	5,050
„ B.—Brush Electrical Engineering Company	9,332
„ C and D.—British Insulated Wire Company	(schedule prices)

These tenders have accordingly been accepted.

Derby.—The Council has accepted the tender of Messrs. S. Z. de Ferranti, Limited, for engine and dynamo at £7,132 10s. Several hundred yards of cable has been ordered for extensions at a cost of £132 14s.

France.—A contract for the construction and working of an electric tramway between Angoulême and Ruelle (Charente) has been secured by the French Thomson-Houston Company.

Leith.—By four votes to three the Town Council has given the contract for the supply and erection of steam dynamos, &c., for the electric lighting of the burgh for the sum of £8,844 to the India-Rubber, Gutta-Percha and Telegraph Works Company.

London.—From the list of tenders submitted to the Metropolitan Asylums Board for the alteration and extension of the electric fire alarm system at the South Eastern Hospital, that of the Private Wire and Telephone Installation Company at £122 10s. was selected for acceptance. The highest tender was £387 10s.!

London.—The tender of Messrs. Bergtheil & Young has been accepted for the electric wiring of the extensions of the Guildhall School of Music.

FORTHCOMING EVENTS.

1898.

Friday, January 21st, at 5 p.m.—Physical Society, at the rooms of the Chemical Society, Burlington House. Agenda:—(1) "On Electric Signalling without Conducting Wires," by Prof. O. Lodge, F.R.S.; (2) A Tesla Oscillator will be exhibited by Prof. S. P. Thompson, F.R.S.

At 8 p.m.—Institution of Junior Engineers, at the Westminster Palace Hotel. Lecture on "Laboratory Testing Machines, and the Latest Example," by Prof. A. C. Elliott, M.Inst.C.E., Hon.M.Inst.J.E., of Cardiff.

Saturday, January 22nd, at 3 p.m.—Institution of Junior Engineers—Visit to the Engineering Laboratory of the Central Technical College, South Kensington. Demonstrations by Prof. W. C. Unwin, F.R.S., Past Pres. Inst.J.E.

Latest date for receipt of Blackburn Corporation tenders.

Monday, January 24th.—Latest date for Newport and Bedford tenders.

At 8 p.m.—Northern Society of Electrical Engineers. Palatine Hotel, Hunt's Bank, Manchester. Paper by Mr. W. P. Adams on "The Cost of Heating and Cooking by Electricity."

Thursday, January 27th.—Latest date for Stockport tenders.

At 8 p.m.—The Institution of Electrical Engineers "Notes on the Electro-Chemical Treatment of Ores containing the Precious Metals." By Major-General Webber, C.B. (ret. R.E.), Past President.

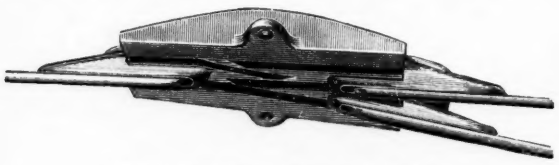
Friday, January 28th, at 8 p.m.—The Institution of Civil engineers. Students' meeting. Paper to be read on "Condensing Apparatus," by H. Williams, Stud.Inst.C.E.

NOTES.

The Damage Due to the Strike.—The Board of Trade returns for December show a falling off, as compared with the same month of 1896, on steam engines from £313,069 to £188,809, and in other machinery from £1,207,930 to £909,339, or a total for the month of £422,851. On making the same calculation for the year, one-half of which was occupied by the strike, the total falling off comes to £732,165, made up of a drop on steam engines from £3,286,353 to £3,040,073, and in other machinery from £13,727,897 to £13,242,012. The total for the year is not double that of December, which month we may set down as merely showing an accidentally large reduction. Obviously the figures for the whole year are safer guides. As there have been other causes than the strike to operate unfavourably during the past year, it may be considered that the strike has, in six months, reduced the exports about £750,000. If one-fifth of this amount would count as profit, and if the wages paid amount to five times the profit, then the loss in wages is just £750,000. The employers have lost £150,000 on this basis, and the men have lost the three-quarters of a million and spent their reserve funds. In six months the falling off has been about 6 per cent. of the year's total, or at the rate of 12 per cent. of six months' output. The figures are bad enough, it is true, but they are not hopeless. Every week is increasing the productive capacity of the fresh hands as well as their number, and the prospects are that, strike or no strike, the present year will show that amalgamated engineers, as such, are not necessary to the employers. No man can be of much use to himself, his country, or his family, for an indefinite period, who orders his goings, or allows others to so order them, in direct contravention of the laws of nature, of common sense, or of common honesty.

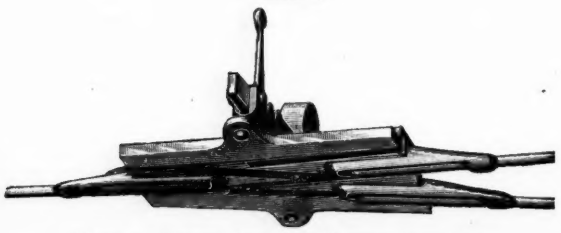
Enclosed Arc Lamps.—Mr. W. H. Freedman concludes an article on this subject in the *American Electrician* as follows:—Besides direct-current enclosed arcs, there are now on the market several makes of alternating enclosed arcs. These have the advantage over the open that the energy employed at the arc may be a higher percentage of the total energy supplied than in the direct. They, however, work best at one particular frequency, which might be in some cases a serious objection. In general, the enclosed arc lamp as compared with the open has the following advantages:—Long life, and consequent saving of carbon, trimming expenses and annoyance from frequent renewals; pleasant light, free from hissing and spluttering, and with very little flickering; absence from flying dust and sparks, and fireproof qualities resulting from the use of two globes; being run on the incandescent circuit, there is no danger from high potentials, and no need of an automatic cut-out; simplicity of mechanism, and, consequently, less need of repairs. Ability to instal only one lamp and not necessarily two. Against the above are, however, to be balanced the disadvantages of lower efficiency, and decrease of light with the time of running.

Overhead Wire Construction.—Mr. W. Wood, engineer-in-charge of the Bristol electric tramways, has devised an improved frog, crossing and movable point for overhead trolley wires, which we illustrate. This type of fitting is specially designed for lines where the swivel trolley is in use,



Frog: Two Lines Running into One.

Crossing.



Movable Point: One Line Running into Two.

the Bristol line being completely equipped with them. The chief feature about the device is, that after the trolley leaves the wire it is guided across the plate by a groove which fits the external diameter of the trolley wheel, and makes a positive path.

Institution of Mechanical Engineers.—The annual general meeting of this institution will be held on Thursday evening, February 10th, and Friday evening, February 11th, at 7.30 p.m., at 25, Great George Street, Westminster. The annual report of the council will be presented to the meeting on Thursday. The retiring president, E. Windsor Richards, Esq., will induct into the chair the president elect, Samuel W. Johnson, Esq. The adjourned discussion will be resumed on the Thursday evening upon the following paper read at the last meeting:—"Mechanical Features of Electric Traction," by Mr. Philip Dawson. Among the papers which will be read and discussed, is "First Report to the Gas Engine Research Committee: Description of Apparatus and Methods, and Preliminary Results," by Prof. Frederic W. Burstall, of Birmingham.

Munro & Jamieson's Pocket-Book of Electrical Rules and Tables.—We are pleased to learn that a 13th edition of this indispensable electrical engineers' pocket-book has been called for, but we hope that the authors and publishers may see their way to reduce its bulk, which has been gradually assuming undue corpulent proportions. We are sure that the authors would appreciate the advice and suggestions of any of our readers as to where they should omit old matter, and where they can, with advantage, insert new data.

Webb Testimonial Fund.—It is intended to make the presentation at a subscription dinner to be given to Mr. and Mrs. Webb by contributors to the Testimonial Fund, on Monday, February 14th, at the Whitehall Rooms of the Hotel Metropole. Tickets may be had from the hon. secretary of the fund, Mr. Henry Edmunds, 39, Victoria Street, Westminster, S.W., the price of single tickets being £1 1s.; and that of double tickets (for a lady and gentleman) being 36s.

Electrical Units.—A Bill is about to be introduced in the German Reichstag concerning electrical units of measurement.

Polyphased Armature Windings.—In another column will be found the first part of an interesting article by Mr. J. P. Stone (*American Electrician*) on the windings of polyphase armatures, which should go far toward dispelling the idea held by many that such windings are especially intricate. As will be seen, says our contemporary in an editorial note, the Y-winding consists merely of two ordinary alternator windings in the case of two-phased machines, or three such windings in the case of three-phased machines. Two-phased windings are entirely disconnected on the armature, an analogy to such a machine, therefore, being two simple alternating-current machines with their shafts rigidly connected, and corresponding wires displaced with reference to the poles, by half the distance between poles. A similar analogy to a Y-wound three-phased machine would be three simple alternators with their shafts rigidly connected, with corresponding wires displaced a third of the distance between poles, and with three collector rings—one ring of each of the three pairs of rings—connected together. The delta winding is merely the usual direct-current winding, tapped at four equidistant points for two-phased working, or at three equidistant points for three-phased working. As pointed out by Mr. Stone, the selection of either type of winding for polyphased machines is merely a matter of convenience. Where a neutral wire is to be run from a three-phased machine, the Y-winding must be used, the neutral running from a fourth collector ring being connected to the common point of the three windings. Such a neutral will supply three additional circuits of a lower voltage than that of the main circuits; that is, if the voltage between the neutral wire and the three main wires is 1,000, the voltage between the three mains will be 1,732. By placing three rings on the commutator of any direct-current machine, the rings being electrically connected to three equidistant bars, the machine will be a three-phased, delta-wound alternator, so far as generating alternating current is concerned.

Storage Battery Traction in Chicago.—The Englewood and Chicago Electric Street Railway Company has been actually in operation exclusively by storage batteries for slightly more than one year, and its cars have just completed 400,000 miles of service. This road, says the *Street Railway Journal*, was built in the most solid and substantial manner expressly for storage battery work. Late in 1896, a few cars from the Madison Avenue (New York City) line were put in service, but it was not until January 1st, 1897, that the first lot of new cars, built expressly for the road, commenced running. This number was increased as rapidly as possible, and last summer, on the heaviest days, 20 30-foot motor-cars, each with a trailer, have been required. The company owns 44 sets of batteries, and up to the present time these batteries have averaged nearly 9,500 miles of service each, the maximum being about 13,500 miles. So far, says our contemporary, there is no perceptible depreciation of the plates, and to all appearances they have yet a long lease of life. Nothing has been spent on maintenance account. The receiver, G. Herbert Condict, states that the entire operating expenses of the road in 1897 amount to but 8 cents per car mile, or 8½ cents including the expenses of the receivership. This is an extraordinarily low figure, even for a trolley line, and one which has never hitherto been approached in storage battery work. The cars run about 200 miles each per day, which is responsible for the low cost per car mile of "car service" labour. Mr. Condict, who is most fair and conservative in his statements, is unwilling as yet to say positively that storage battery traction is on this road cheaper than the overhead system would be, but says that if the batteries, which, as before stated, are apparently in as good a condition as when first installed, will last for 8,000 to 10,000 miles more, a distinct economy in comparison with the overhead system would be shown.

Obituary.—We regret to hear of the death of Mr. Wm. Patterson, of the City Wire Works, Walkergate, Newcastle-on-Tyne, whose change of address we notified last week. Mr. Patterson's death occurred on 11th inst. The business will be continued by Mrs. Patterson, under the management of Mr. Scott.

Lectures.—A course of 12 lectures is to be given at Honiton on "Magnetism and Electricity," under the auspices of the Devon County Council, by Mr. F. Brett.

Royal Institution.—Prof. J. A. Fleming is to deliver a series of five afternoon lectures on "Recent Researches in Magnetism and Diamagnetism" in March, as follows:—Thursday, March 3rd, "Ferro-magnetism;" March 10th, "Para-magnetism;" March 17th, "Diamagnetism;" March 24th, "Thermo-magnetism;" March 31st, "Magnetic Theories."

Appointment Vacant.—The Barrow-in-Furness Corporation are advertising for a resident electrical engineer at £200 per annum, to take charge of the electric light undertaking. See our "Official Notices" for particulars.

The Royal Society.—Among the papers down for reading yesterday afternoon were:—Prof. W. Ramsay, F.R.S., and Morris W. Travers, on (1) "The Homogeneity of Helium;" (2) "Fergusonite, an Endothermic Mineral." T. Preston, "On the Modifications of the Spectra of Iron and Other Substances radiating in a Strong Magnetic Field."

Marriage.—On January 11th, Mr. Tom Hesketh was married to Miss Fanny T. Dewhurst at Christ Church, Southport. Mr. Hesketh was, until very recently, assistant electrical engineer at the Hampstead Electricity Works.

Paper.—Before the Newcastle Students' Association of the Institution of Civil Engineers, a paper was read on 12th inst., at the Durham College of Science by Mr. John F. C. Snell, on "The Advantages of Direct Current Supply from Central Stations."

Such is Life!—"It may be that not to know Mr. Yorke, electrical engineer, of Glasgow, argues oneself unknown, but I must plead guilty to not having heard of the gentleman a week ago." So writes the editor of a contemporary who usually implies that what he doesn't know is not worth knowing. And yet the columns of the ELECTRICAL REVIEW have for some years past testified to the existence of Mr. Yorke.

Electric Launches.—Mr. Justus Eck writes as follows respecting our recent note on "Electric Launch for the Czar of Russia":—"It may interest you to know that at the same time an order was placed in America for the above, another was placed in this country with Messrs. Kerby Bowen, Limited, and that this is now being built in the Isle of Wight, under the supervision of the Naval Attaché of the Russian Embassy in London. Many new ideas are being incorporated in this launch, but those responsible for the same do not intend to point out their advantages till they have been approved by practical experience. This order probably followed from the construction by the above company of successful launches for German, French and Austrian steamship and armament companies, and private (and sometimes Royal) individuals, not to speak of British customers. It will be of interest, when the time arrives, to compare the relative advantages of the launches, one all American, and the other all English manufacture."

CITY NOTES.

The Yorkshire House-to-House Electricity Company, Limited.

WE have more than once congratulated the admirably managed Leeds Company upon the smartness with which it issues its annual report. Not only do we again compliment the managers upon the celerity with which they have presented the statement of affairs to the proprietors, but we must also draw attention to the extremely low cost of production which has marked the conduct of the business. We thought that Mr. Dickinson did something very noteworthy last year when he showed the cost per unit to be 1·65d., but that figure has now been decreased by ·23d., the total cost per unit during 1897 being 1·42d. and the works' cost 1·02d. The following are the chief points in the directors' report:—

"The profit for the year, after transferring £2,300 to the depreciation fund account, amounts to £10,703 1s. 11d., to which is to be added the sum of £392 12s. 2d. brought forward from the previous year, making a total of £11,095 14s. 1d., which the directors propose shall be appropriated as follows:—

To reserve fund account			£3,000 0 0
„ Payment of interim dividend at the rate of 5 per cent. per annum on the amount called and paid up on the ordinary shares of the company, for the half-year ending June 30th, 1897	£2,624	8 1	
„ Payment of a dividend on the amount called and paid up on the same shares, which, with the interim dividend previously paid, will equal a dividend at the rate of 6 per cent. per annum for the year ending December 31st, 1897 ...	4,142	3 7	
			6,766 11 8
„ Balance to carry forward to next account			1,329 2 5
			£11,095 14 1

"The company's works and plant have been maintained in a thoroughly efficient state of repair.

"The number of lamps connected to the mains, which, on December 31st, 1896, was equivalent to 39,396 35-watt lamps, had increased by December 31st, 1897, to 49,150 such lamps.

"In accordance with the resolution passed at the last general meeting, 18,948 ordinary shares were, on February 2nd, 1897, offered at par to the then existing members of the company, and 18,626 shares were applied for and allotted. The directors carefully considered the suggestion made at the same meeting in favour of extinguishing the founders' shares in the company, but came to the conclusion that it is not yet practicable to effect such an operation.

"The company's new buildings are practically completed, and contracts have been made during the year for additional engines and alternators of a total capacity of 1,500 indicated horse-power (or 900 kilowatts). The greater portion of this plant is expected to be ready for use in a few weeks, and the remainder during the coming summer.

"A large expenditure has been incurred in the provision of improved means of distributing electrical energy in the central parts of the City. The mains have been considerably extended in the direction of Kirkstall, and an extension will shortly be made in Meadow Road.

"A reduction in the charge for electrical energy has been made, taking effect on January 1st, 1898, the maximum price having been reduced from 6d. to 5d. per unit. The charge previously made for connecting premises has been abolished, except in cases where the wires have to be carried exceptional distances, and the minimum charge of 13s. 4d. per quarter for current (authorised by the company's provisional order) is not now enforced. These modifications will represent a future total concession of several thousands of pounds per annum, but the directors decided upon them in the expectation of a compensating additional consumption.

"The Leeds Corporation have in contemplation the purchase of the company's undertaking."

The following table gives the cost per unit:—

	1897.	1896.
Total capital expended	£131,992	£105,377
Number of units sold	833,280	701,409
Number of lamps connected	49,150	39,396
Revenue from sale of current	£16,262	£14,728
Net revenue	£10,754	£7,475
Average price obtained per unit	—	—

Cost of production.	£		Per unit.	1896.
Coal	876		·25d.	·29d.
Oil, waste, water and engine room stores	184		·05d.	·07d.
Salaries and wages at generating station	2,041		·59d.	·66d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	444	(Works' cost 1·02d.)	·13d.	·22d.
Rent, Rates and taxes	—		—	—
Management expenses, directors' remuneration, salaries of managing engineer, secretary, clerks, &c., stationery and printing, general establishment charges, auditors, law charges, and insurance	1,406		·40d.	·41d.
Depreciation of buildings and plant account	—		—	—
Renewal fund account	—		—	—
Total	£4,951		1·42d.	1·65d.

Revenue.	£	s.	d.	Average price obtained per unit.
By sale of current	17,127	0	0	—
Meter rents, &c.				
Supply of steam	—			—
Transfer fees	—			—
Total	£17,127	0	0	

Total cost per unit (exclusive of depreciation and renewal accounts), 1·42d.; works' cost, 1·02d.

The Dividends for 1897.

ALTHOUGH so short a time has elapsed since the close of the year, announcements of dividends are already being made. One has for a considerable time looked upon the St. James' and Westminster in the nature of gilt-edged securities, and this view receives ample confirmation from the dividends just declared.

The following list gives the dividends announced, with the corresponding ones for the previous three years:—

LONDON.	1897.	1896.	1895.	1894.
St. James' and Pall Mall	14½	10½	7¼	6¼
Westminster	12	9	7	5
PROVINCIAL.				
Yorkshire House-to-House Company ...	6	6	5	4

The St. James' and Pall Mall Electric Light Company, Limited.

AT an extraordinary general meeting of this company held at Carnaby Street, Golden Square, London, W., on Tuesday, the following resolutions were considered and adopted:—"That the agreement bearing date the 16th day of December, 1897, and made between the company of the first part, the parties whose names are subscribed in the first column of the schedule thereto being the registered holders of the 100 founders' shares of £1 each in the company of the second part, and Eustace James Anthony Balfour and Josiah Latimer Clark of the third part, be, and the same is hereby approved, and that the directors be and they are hereby authorised to carry the same into effect. That the capital of the company be increased to £300,000 by the creation of 20,000 new ordinary shares of £5 each, and that, notwithstanding the provisions of article 4 of the articles of association, 12,000 of such 20,000 new ordinary shares of £5 each be issued at par to the registered holders of the 100 founders' shares of £1 in the company as provided by the said agreement of the 16th day of December, 1897. That the directors be and they are hereby authorised to issue to any registered holder of a founders' share at any time hereafter not more than 120 new ordinary shares of £5 each at par upon such founders' shareholder transferring each founders' share of which he is the registered holder to Eustace James Anthony Balfour and Josiah Latimer Clark as trustees for the company, notwithstanding that the said agreement of the 16th day of December, 1897, may not have been executed by the holders of the whole of the said 100 founders' shares within the three months provided by clause 5 thereof."

The Direct United States Cable Company, Limited.

THE report of the directors for the six months ended December 31st, 1897, to be presented at the forty-first ordinary general meeting of the company, to be held at Winchester House on Tuesday, January 25th, 1898, at 2 o'clock p.m., states that the usual statements of account for the half-year ended December 31st, 1897, are submitted herewith. The half-year's revenue, after deducting out-payments, amounted to £50,098 2s. 8d., as compared with £47,601 2s. 1d. for the corresponding period of 1896, showing a difference of £2,497 0s. 7d. in favour of the half-year under review. The working and other expenses for the same period, including income-tax, but exclusive of cost of renewal and repairs of cable, amounted to £19,722 13s. 10d., leaving a balance of £30,375 8s. 10d. as the net profit, making, with £3,927 13s. 4d. brought forward from the previous half-year, a total of £34,303 2s. 2d. For the corresponding period of 1896 the working expenses and other payments amounted to £19,815 13s. 6d. Interim dividends of 3s. per share for the quarter ended September 30th, 1897 (paid October 26th, 1897), and of 3s. per share for the quarter ended December 31st, 1897 (payable January 29th, 1898), together amounting to £18,213, have been declared, and after setting aside £12,000 to the reserve fund account, the balance of £4,090 2s. 2d. on the revenue account has been carried forward. The reserve fund account has been debited with £8,325 0s. 11d. for cost of cable and repairs, and with £2,000 written off the Ballinskelligs Buildings account, and after being credited with interest on investments, and sum transferred from revenue account, the balance of the reserve fund now amounts to £345,767 17s. 9d.

Blackpool and Fleetwood Tramroad Company.

AN extraordinary meeting of the shareholders of this company was held last week in Association Chambers, Manchester, to authorise the promotion in Parliament of a Bill to give the company powers to construct tramways in Blackpool. Mr. George Richardson presided. It is proposed to construct a double line from Regent Terrace along the Carriage Drive, authorised by the Blackpool Improvement Act, 1893; a single line from Queen Square to the Carriage Drive, and a single line from Dickson Road to Queen Street. But it was explained to the meeting that it would not be necessary to construct these lines if the company obtained, as they hoped to do, running powers over the lines of the Blackpool Corporation. The company propose to take powers to raise £75,000 of additional capital. If it becomes necessary to issue new shares these will be offered at par to the present shareholders.

The CHAIRMAN, in moving the adoption of a resolution approving of the Bill, said the line to Fleetwood was being rapidly pushed forward, and would probably be open for traffic by May 1st.

The resolution was adopted.

The Eastern Telegraph Company.

THE half-yearly meeting of this company was held at Winchester House yesterday. The Marquis of Tweedale presided, and referred to the increase in the revenue and the working expenses. The Cape traffic had fallen off, but that had been more than counterbalanced by an increase in the Indian traffic, due to the disturbances on the frontiers. After referring to the improvements made in the system from time to time, the report was adopted.

An extraordinary meeting was subsequently held for approving the conversion of the existing preference shares.

Stock Exchange Settlements.—Applications have been made to the Stock Exchange Committee (1) to appoint a special settling day in, and to grant a quotation to: Bournemouth and Poole Electricity Supply Company, Limited—6,000 4½ per cent. cumulative preference shares, and 6,000 ordinary shares; County of London and Brush Provincial and Electric Lighting Company, Limited—further issue of 10,000 ordinary shares; Direct West India Cable Company, Limited—12,000 shares; (2) to appoint a special settling day in Cape Electric Tramways, Limited—285,157 vendors' £1 shares, fully paid, Nos. 1 to 285,157; and (3) to allow the following securities to be quoted in the Official List: Barcelona Tramways Company, Limited—further issue of 5,072 ordinary shares, Nos. 14,929 to 20,000; Direct West India Cable Company, Limited—£120,000 4½ per cent. registered debentures; Halifax and Bermudas Cable Company, Limited—5,000 shares, Nos. 1 to 5,000, and £103,500 4½ per cent. first mortgage debentures. Also to appoint a special settling day in, and to grant a quotation to:—West Coast of America Telegraph Company, Limited—30,008 shares of £2 10s. each, and £150,000 4 per cent. debentures, in lieu of the shares and debentures of the old company of the same name now quoted; and to allow the following securities to be quoted in the Official List:—Commercial Cable Company—Further issue of £264,711 sterling 4 per cent. 500-year debenture stock.

City and South London Railway Company.—The accounts for the half-year ended December 31st show a balance, after providing for the debenture interest and the full dividend on the 5 per cent. preference shares, sufficient to allow the payment of a dividend on the consolidated ordinary stock at the rate of 1¾ per cent. per annum, carrying forward a balance of £1,511 to the new account. The dividend for the corresponding period last year was at the rate of 1¾ per cent. per annum, the balance carried forward being £1,314.

City of London Electric Lighting Company.—All outstanding forms of application (with the banker's receipt for the payment upon application which is attached thereto), and all certificates for fifths of a share of the issue of 10,000 ordinary shares, November, 1897 (Nos. 90,001 to 100,000), must be lodged with the company on or before 31st inst., otherwise the same will be liable to to cancellation or forfeiture at the discretion of the board.

The Eastern Extension, Australasia and China Telegraph Company, Limited.—This company notifies that the interest on the 4 per cent. mortgage debenture stock for the half-year ended 31st inst. will be paid by warrant on February 1st next. The stock register will be closed from the 27th to the 31st inst., both days inclusive.

Westminster Electric Supply Corporation.—During the past week this company has offered 3½ per cent. debentures to the extent of £200,000 for subscription. They were issued at par, redeemable in March, 1920, at par. We learn from the financial press that the issue was subscribed four times over.

The St. James' and Pall Mall Electric Light Company, Limited.—The Directors recommend a dividend for half-year ending December 31st of 11s. per share on the ordinary shares, making, with the interim dividend, 14½ per cent. for the year 1897.

Electric Construction Company.—The transfer books for the ordinary shares will be closed from 18th to 31st inst. inclusive, for the payment of the second half of the dividend of 6 per cent. per annum declared on July 22nd last.

The Globe Telegraph and Trust Company.—The directors announce an interim dividend of 1s. 9d. per share on the ordinary shares.

Oldham, Ashton and Hyde Electric Tramway.—The letters of allotment have been posted.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending January 16th, 1898, were £1,085; week ending January 17th, 1897, £1,085; total receipts for half-year, 1898, £3,259; corresponding period, 1897, £3,273; decrease, £14.

The Liverpool Overhead Railway Company. The receipts for the week ending January 16th, 1898, amounted to £1,361; corresponding week last year, £1,278; increase, £83.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending January 14th, 1898, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £3,940.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1895.	1896.	1897.	Closing Quotation, Jan. 12th.	Closing Quotation, Jan. 19th.	Business done during week ended Jan. 19th, 1898. Highest.	Lowest
137,400£	African Direct Teleg., Ltd., 4 % Deb.	100	4 %	...	...	100 —104	100 104	...	...
25,000	Amazon Telegraph, Limited, shares...	10	...	...	...	6 — 7	6 — 7	...	...
125,000	Do. do. 5 % Debs. Red.	100	...	...	...	... — ...	93 — 96	...	...
923,960£	Anglo-American Teleg., Ltd.	Stock	£2 9s.	£2 13s.	...	61 — 63	61 — 63	61⅜	...
3,038,020£	Do. do. 6 % Pref.	Stock	£4 18s.	£5 6s.	...	111 - 112	111 - 112	112	111½
3,038,020£	Do. do. Defd.	Stock	...	...	...	13½ — 14	13½ — 14	13 1/16	13½
130,000	Brazilian Submarine Teleg., Ltd.	10	7 %	...	...	16¼ — 16⅜	16¼ — 16⅜	16⅜	16⅜
75,000£	Do. do. 5 %, Debs., 2nd series, 1936	100	5 %	...	...	112 —116	112 —116	...	...
44,000	Chili Telep., Ltd., Nos. 1 to 44,000	5	4 %	4 %	...	3 — 3½	3 — 3½	...	...
10,000,000$	Commercial Cable Co.	$100	7 %	7 %	...	182 —187	185 —190	190	...
653,586£	Do. Do. Sterling 500 year 4% Deb. Stock Red.	Stock	...	...	...	105 —107	105 —107	107	105⅞
224,850	Consolidated Telep. Const. and Main., Ltd.	10/-	1½%	2 %	...	3/16 — 5/16	3/16 — 5/16	...	...
16,000	Cuba Teleg., Ltd.	10	8 %	8 %	...	8 — 9	8 — 9	9	...
6,000	Do. 10 % Pref.	10	10 %	10 %	...	18 — 19	18 — 19	...	...
12,931	Direct Spanish Teleg., Ltd.	5	4 %	4 %	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	10 — 11	10 — 11	...	...
30,000£	Do. do. 4½ % Debs. Nos. 1 to 6,000	50	4½%	4½%	...	102 —105%	103 —106%	...	...
60,710	Direct United States Cable, Ltd.	20	2½%	2½%	...	10½ — 11	10½ — 10⅝xd	10⅝	10⅜
400,000	Eastern Teleg., Ltd., Nos. 1 to 400,000	10	6½%	6½%	...	17½ — 17¾	17⅝ — 18¼xd	18 1/16	17⅝
70,000	Do. 6 % Cum. Pref.	10	6	6%	...	18 — 19	18½ — 19½xd	18⅝	18½
89,900£	Do. 5 % Debs., repay. August, 1899	100	5 %	5%	...	102 —105	102 —105	...	...
1,302,615£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4%	...	130 —133	131 —134	133½	131½
250,000	Eastern Extension, Australasia and China Teleg., Ltd.	10	7 %	7½	...	18½ — 19	18⅝ — 19¼xd	19⅛	18½
25,200£	Do. 5 % (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	5 %	5%	...	99 —103	99 —103	101	...
100,500£	Do. do. Bearer, 1,050—3,975 and 4,327—5,400	100	5 %	5%	...	100 —103	100 — 103	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4%	...	132 —135	132 —135	134	...
51,100£	Eastern and South African Teleg., Ltd., 5 % Mort. Deb. 1900 redeem. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	5%	...	99 —103	99 — 103	...	...
69,200£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	5%	...	100 —103	100 —103	...	...
300,000£	Do. 4 % Mort. Debs. Nos. 1 to 3,000, red. 1909	100	4 %	4%	...	103 —106	104 —107	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4%	...	108 —111%	108 —111%	...	...
180,227	Globe Telegraph and Trust, Ltd.	10	4½%	4½%	...	11⅜ — 12¼	11⅜ — 12¼	12⅛	11⅞
180,042	Do. do. 6 % Pref.	10	6 %	6%	...	17¾ — 18¼	17¾ — 18¼	18¼	17⅞
150,000	Great Northern Teleg. Company of Copenhagen	10	10 %	10%	...	25½ - 26½	27 — 28	26⅝	...
160,000£	Do. do. do. 5 % Debs.	100	5 %	5%	...	101 —104	101 —104	...	...
17,000	Indo-European Teleg., Ltd.	25	10 %	10%	...	52 — 55	52 — 55	53⅞	...
100,000£	London Platino-Brazilian Teleg., Ltd. 6 % Debs.	100	6 %	6%	...	107 —110	108 —111	109½	...
28,000	Montevideo Telephone 6% Pref., Nos. 1 to 28,000	5	4 %	...	...	2 — 2½	2 — 2½	...	...
484,597	National Teleph., Ltd., 1 to 484,597	5	5½%	5½%	...	6½ - 6¾	6⅝ — 6⅞	6⅞	6 11/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	...	15 — 17	15 — 17	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	...	14 — 16	14 — 16	15 1/16	...
119,234	Do. 5 % Non-cum. 3rd Pref., 1 to 119,234	5	5 %	5 %	...	6 — 6½	6 — 6½	6⅝	...
130,766	Do. do. Nos. 119,235 to 250,000, £5 paid	5	...	...	...	5¾ — 6¼	6 — 6½	...	...
329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	...	102 —107	102 —107 xd	105½	...
171,504	Oriental Teleph. & Elec., Ltd., Nos. 1 to 171,504, fully paid	1	5 %	5 %	...	9/16 — 11/16	5/8 - 3/4	11/16	...
100,000£	Pacific and European Tel., Ltd., 4 % Guar. Debs, 1 to 1,000	100	4 %	4 %	...	105 - 108	105 —108	...	...
11,839	Reuter's Ltd.	8	5 %	5 %	...	7½ - 8½	7½ - 8½	8⅜	8
3,381	Submarine Cables Trust	Cert.	...	...	...	136 - 141	138 - 143	143	142½
58,000	United River Plate Teleph., Ltd.	5	4 %	...	...	4 — 4½	4 — 4½	4 5/16	...
146,733£	Do. do. 5 % Debs.	Stock	5 %	...	...	101 - 106	101 —106	103½	...
15,609	West African Teleg., Ltd., 7,501 to 23,109	10	4 %	nil	...	4 — 5	4 — 5	...	...
213,400£	Do. do. do. 5 % Debs.	100	5 %	5 %	...	103 —106	103 - 106	...	...
64,268	Western and Brazilian Teleg., Ltd.	15	3 %	2 %	...	9⅜ - 10½	9⅜ - 10½	9⅜	...
33,129	Do. do. do. 5 % Pref. Ord.	7½	5 %	5 %	...	7½ — 7⅝	7½ — 8	7 11/16	7⅝
33,129	Do. do. do. Def. Ord.	7½	1 %	...	...	2⅜ - 3¼	2⅜ — 3¼	...	...
382,230	Do. do. do. 4 % Deb. Stock Red.	Stock	...	...	...	104 —107	104 —107	105	...
88,321	West India and Panama Teleg., Ltd.	10	¾%	1 %	...	⅜ - ⅝	⅜ - ⅝	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	...	7¼ — 7⅝	7 — 7½	7½	7½
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	...	5 — 7	5 — 7	...	...
80,000£	Do. do. 5 % Debs. No. 1 to 1,600	100	5 %	5 %	...	105 —108	105 —108	...	...
1,163,000$	Western Union of U. S. Teleg., 7 % 1st Mort. Bonds	$1000	7 %	7%	...	105 —110	105 —110	...	...
160,100£	Do. do. 5 % Ster. Bonds.	100	5 %	5%	...	100 —105	100 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electy. Supply	5	5 %	6 %	...	12½ — 13½	12½ — 13½	13½	...
20,000	Do. do. do. 4½ % Cum. Pref.	5	...	...	...	6½ — 6⅝	6½ — 6⅝	6 11/16	...
26,000	*Chelsea Electricity Supply, Ltd., Ord., Nos. 1 to 10,277	5	5 %	5 %	...	10½ — 11	10½ — 11	10⅞	...
60,000	Do. do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	...	112 —114	112 —114	...	...
40,000	City of London Elec. Lighting Co., Ltd., Ord. 40,001—80,000	10	5 %	7 %	...	26 — 27	27½ - 28½	28	26⅞
10,000	Do. do. Prov. Certs.	5	...	...	...	25¼ — 26½	27 — 28	25½	...
40,000	Do. do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	...	17 — 18	17 — 18	17⅝	17½
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	...	129 —134	129 —134	...	...
30,000	County of Lond. & Brush Prov. E. Ltg. Ltd., Ord. 1—30,000	10	*nil*	*nil*	...	13⅜ — 14½	13⅜ — 14½	14½	14
20,000	Do. do. do. 6% Pref., 40,001—60,000	10	6 %	6 %	...	15½ — 16	15½ — 16	15 15/16	15⅞
10,000	House-to-House Elec. Light Supply, Ord., 101 to 10,100	5	...	...	...	9 — 10	9 — 10	9½	...
10,000	Do. do. 7 % Cum. Pref.	5	...	...	...	11 — 11½	11 — 11½	11½	...
49,900	*Metropolitan Electric Supply, Ltd., 101 to 50,000	10	4 %	5 %	...	18½ — 19½	18 — 19	18 15/16	18⅝
12,500	Do. Ord., 50,001—62,500, iss. at £2 prem.	10	...	...	...	18 — 19	18 — 19	18⅝	...
220,000	Do. 4½% first mortgage debenture stock	...	4½%	4½%	...	117 — 121	117 —121	...	...
6,452	Notting Hill Electric Lightg. Co., Ltd.	10	2 %	4 %	...	17½ — 18½	17½ — 18½	...	...
19,980	*St. James's & Pall Mall Elec. Light Co., Ltd., Ord., 101-20,080	5	7½%	10½%	14½ %	17 — 18	17½ — 18½	18	17½
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	...	10 — 11	10 — 11	10⅜	10⅜
50,000	Do. do. 4 % Deb. stock Red.	Stock	...	...	...	101 —104	101 —104	...	...
43,341	South London Electricity Supply, Ord., £2 paid	5	...	...	...	2⅝ — 2⅞	2⅞ — 3⅛	3 1/16	2 13/16
79,900	Westminster Electric Supply Corp., Ord., 101 to 80,000	5	7 %	9 %	12 %	16 — 17	16 — 17	16⅝	16 7/16

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid. § Dividends paid in deferred share warrants, profits being used as capital.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL, COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1895.	1896.	1897.	Closing Quotation, Jan. 12th.	Closing Quotation Jan. 19th.	Business done during week ended Jan. 19th, 1898. Highest	Lowest
30,000	British Electric Traction	10	...	...	...	17½ — 18	17½ — 18	17⅝	17½
90,000	Brush Elect. Engng. Co., Ord., 1 to 90,000...	3	...	...	...	1⅞ — 2⅛	2 — 2¼	2¼	2 1/16
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	...	...	...	2⅛ — 2⅜	2¼ — 2½	2⅜	2¼
125,000£	Do. do. 4½ % Perp. Deb. Stock.... ...	Stock	...	...	...	109 — 113	109 — 113	112	...
50,000	Do. do. 4½% 2nd Deb. Stock Red. ...	Stock	...	...	...	00 —103	102 —105	102½	...
19,126	Central London Railway, Ord. Shares	10	...	...	...	9⅜ — 10¼	9⅜ — 10¼	10⅛	9¼
143,106	Do. do. do. £6 paid	10	...	...	...	5½ — 6	5½ — 6	5¹⅝	5⅜
58,830	Do. do. Pref. half-shares £1 pd. ...	...	...	...	...	1¼ — 1⅜	1¼ — 1⅜	...	...
61,777	Do. do. Def. do. £5 pd. ...	...	...	...	...	4 — 4½	4 — 4½	4⅜	...
630,000£	City and South London Railway	Stock	1⅝%	1⅝%	1⅞	69 — 71	69 — 71	70	69½
28,180	Crompton & Co., Ltd., 7 % Cum. Pref. Shares, 1 to 28,180	5	*nil*	...	...	2 — 2½	2 — 2½	...	...
99,261	Edison & Swan United Elec. Lgt., Ltd., "A" shrs, £3 pd. 1 to 99,261	5	5 %	5½%	...	2½ — 3	2½ — 3	...	...
17,139	Do. do. do. "A" Shares 01—017,139	5	5 %	5½%	...	4½ — 5½	4½ — 5½	...	...
110,000	Electric Construction, Ltd., 1 to 110,000	2	5 %	6 %	...	2⅜ — 2⅝	2⅜ — 2⅝	2 13/16	2 11/16
16,343	Do. do. 7 % Cum. Pref., 1 to 16,343 ...	2	7 %	7 %	...	3⅛ — 3⅜	3⅛ — 3⅜	3 5/16	...
91,195	Elmore's Patent Cop. Deposg., Ltd., 1 to 70,000	2	...	...	...	⅛ — ¼	⅛ — ¼	...	...
67,275	Elmore's Wire Mfg., Ltd., 1 to 69,385, issued at 1 pm. ...	2	...	...	...	⅛ — ¼	⅛ — ¼	...	...
9,600£	Greenwood & Batley, Ltd., 7 % Cum. Pref., 1 to 9,600 ...	10	10½%	...	...	9 — 11	9 — 11	...	...
12,500	Henley's (W. T.) Telegraph Works, Ltd., Ord.	10	8 %	10 %	...	20½ — 21½	21 — 22	...	...
3,000	Do. do. do. 7% Pref.	10	7 %	7 %	...	18½ — 19½	18½ — 19½	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock	Stock	4½%	4½%	...	110 —115	110 — 115	...	...
50,000	India-Rubber, Gutta Percha and Teleg. Works, Ltd. ...	10	10 %	10 %	...	23½ — 24½	23½ — 24½	23⅞	23⅝
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	103 —107	103 —107	...	..
37,500	†Liverpool Overhead Railway, Ord.	10	2½%	2½%	...	11 7/16 — 11 9/16	11⅜ — 11½	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	...	16 — 16½	16 — 16½	..	...
37,350	Telegraph Constn. and Maintce., Ltd.	12	15 %	15 %	...	36 — 39	38 — 41	41	...
150,000	Do. do. do. 5 % Bonds, red. 1899	100	5 %	5 %	...	101 —104	102 —105	102½	...
54,000£	Waterloo and City Railway, Nos. 1 to 54,000	10	...	...	...	12½ — 13	12½ — 13	12⅞	12 11/16

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.

Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

CROMPTON & Co.—The dividends paid on the ordinary shares (which have not a Stock Exchange quotation), are as follows: 1892—0%; 1891—7%; 1890—8%.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

* Birmingham Electric Supply Company, Ordinary of £5 £4 paid, 7⅛, £5 (fully paid) 11.

Electric Construction Corporation, 6 % Debentures, 105—106.

House-to-House Company, 4½% Debentures of £100, 108 -110.

Kensington and Knightsbridge Electric Lighting Company, Limited Ordinary Shares £5 (fully paid) 15—15½; 1st Preference Cumulative 6 %, £5 (fully paid), 8¼—8⅜. Dividend, 1896, on Ordinary Shares 7 %.

London Electric Supply Corporation, £5 Ordinary, 3—3¼.

* T. Parker, Ltd., £10 (fully paid), 11⅝—12½.

Yorkshire House-to-House Electricity Company, £5 Ordinary Shares fully paid, 8¼—8¾. Dividend for 1896—6 %.

* From Birmingham Share List.

Bank rate of discount 3 per cent. (October 14th, 1897).

THE APPLICATION OF VECTOR ALGEBRA TO ALTERNATING CURRENTS.

By W. G. RHODES, M.Sc., Royal Technical Institute, Salford.

(*Concluded from page 56.*)

STATIONARY TRANSFORMER.

23. We will now apply the method to the study of a stationary transformer in which the reactances and mutual inductions may be considered constant.

Let the resistance of the primary circuit be r_1, its reactance s_1, and the primary current i_1, and let the corresponding quantities for the secondary circuit (internal and external), be r_2, s_2, and i_2, the mutual induction between the two circuits M; and the potential difference applied between the primary terminals, e.

Then, following the argument of Section 21, the vector equation of E.M.Fs. in the primary circuit is

$$r_1 i_1 + k s_1 i_1 + k p \mathrm{M} i_2 = e. \qquad (28)$$

The E.M.F. in the secondary circuit due to mutual induction is $-k p \mathrm{M} i_1$. This has to furnish a component, $r_2 i_2$, in phase with the secondary current to drive the current against the ohmic resistance of the circuit, and also a component, $k s_2 i_2$, to balance the E.M.F., $-k s_2 i_2$, due to the secondary reactance. We thus have the vector E.M.F. equation

$$r_2 i_2 + k s_2 i_2 = -k p \mathrm{M} i_1,$$

or

$$r_2 i_2 + k s_2 i_2 + k p \mathrm{M} i_1 = 0. \qquad (29)$$

Equations (28) and (29) are then the vector E.M.F. equations of the primary and secondary circuit respectively. Eliminating first i_2 and then i_1, we get

$$\{(r_1 r_2 - s_1 s_2 + p^2 \mathrm{M}^2) + k (r_1 s_2 + r_2 s_1)\} i_1 = (r_2 + k s_2) e$$

and

$$\{(r_1 r_2 - s_1 s_2 + p^2 \mathrm{M}^2) + k (r_1 s_2 + r_2 s_1)\} i_2 = -k p \mathrm{M} e$$

which may be written in the forms

$$\left[\{r_1 (r_2^2 + s_2^2) + p^2 r_2 \mathrm{M}^2\} + k \{s_1 (r_2^2 + s_2^2) - p^2 s_2 \mathrm{M}^2\}\right] i_1 = (r_2^2 + s_2^2) e \qquad (30)$$

and

$$\{-(r_1 s_2 + r_2 s_1) + k (r_1 r_2 - s_1 s_2 + p^2 \mathrm{M}^2)\} i_2 = p \mathrm{M} e \qquad (31)$$

Hence the *magnitudes* of the primary and secondary currents are given by

$$\left.\begin{aligned} i_1 &= \frac{e}{\sqrt{\left\{ r_1^2 + s_1^2 + 2 p^2 \mathrm{M}^2 \frac{(r_1 r_2 - s_1 s_2)}{r_2^2 + s_2^2} + \frac{p^4 \mathrm{M}^4}{r_2^2 + s_2^2} \right\}}} \\ i_2 &= \frac{p \mathrm{M} e}{\sqrt{\{(r_1^2 + s_1^2)(r_2^2 + s_2^2) + 2 p^2 \mathrm{M}^2 (r_1 r_2 - s_1 s_2) + p^4 \mathrm{M}^4\}}} \end{aligned}\right\} \qquad (32)$$

If R and S are the equivalent resistance and reactance of the primary circuit, we get at once from equation (30)

$$\left.\begin{aligned} \mathrm{R} &= r_1 + \frac{p^2 r_2 \mathrm{M}^2}{r_2^2 + s_2^2} \\ \text{and} \quad \mathrm{S} &= s_1 - \frac{p^2 s_2 \mathrm{M}^2}{r_2^2 + s_2^2} \end{aligned}\right\} \qquad (33)$$

From equation (30) we also see that the primary current lags behind the applied potential difference by an angle θ, where

$$\tan\theta = \frac{s_1 (r_2^2 + s_2^2) - p^2 s_2 \mathrm{M}^2}{r_1 (r_2^2 + s_2^2) + p^2 r_2 \mathrm{M}^2},$$

whence the current and applied potential difference are in phase if

$$s_1 s_2^2 - p^2 \mathrm{M}^2 s_2 + s_1 r_2^2 = 0, \qquad (34)$$

that is, for a given primary reactance there are two values of the secondary reactance for which resonance may occur in the primary circuit, provided the roots of equation (34) are real, that is, if

$$p^2 \mathrm{M}^2 > 2 s_1 r_2.$$

From equation (31) we see that the secondary current lags behind the primary potential difference by an angle $\pi - \phi$, where

$$\tan\phi = \frac{r_1 r_2 - s_1 s_2 + p^2 \mathrm{M}^2}{r_1 s_2 + r_2 s_1}.$$

It is evident from this that the secondary current is in exact opposition to the primary applied potential difference if

$$r_1 r_2 - s_1 s_2 + p^2 \mathrm{M}^2 = 0, \qquad (35)$$

and this condition is satisfied for one value only of s_2.

Moreover, conditions (34) and (35) cannot be satisfied simultaneously, since then we should also have

$$r_1 s_2 + r_2 s_1 = 0,$$

and the secondary current would be infinite, as is seen by reference to equation (31).

If condition (34) is satisfied we see from equation (30) that the primary current is given by

$$i_1 = \frac{e}{r_1 + \frac{s_1}{s_2} \cdot r_2} \qquad (36)$$

which shows that even if the primary current is in phase with the impressed potential difference, its value depends upon the resistance of the secondary circuit, and the ratio of the reactances of the two circuits, as well as upon the primary resistance.

Again, from equations (32) we have

$$\frac{i_1}{i_2} = \frac{\sqrt{r_2^2 + s_2^2}}{p\,\mathrm{M}}.$$

If now the secondary resistance is negligible compared with its reactance, and if its reactance is due simply to its self-induction L_2, this becomes

$$\frac{i_1}{i_2} = \frac{\mathrm{L}_2}{\mathrm{M}}.$$

If, further, there is no leakage, so that $\mathrm{M}^2 = \mathrm{L}_1 \mathrm{L}_2$, L_1 being the primary self-induction,

$$\frac{i_1}{i_2} = \sqrt{\frac{\mathrm{L}_2}{\mathrm{L}_1}} = \frac{\mathrm{N}_2}{\mathrm{N}_1}$$

where N_1 and N_2 are the number of turns on the primary and secondary coils respectively.

24. As a last example we will consider the action of an induction motor.

THE INDUCTION MOTOR.*

A multiphase induction motor may be considered as a transformer with its secondary circuit free to rotate. The primary coils are wound round a stationary laminated iron framework, and are fed by two or more alternating currents differing in phase from each other, so as to produce a more or less uniform magnetic field rotating with a more or less uniform angular velocity. We shall here suppose that the magnetic field is uniform and that its angular velocity is uniform also.

The secondary circuit usually consists of a number of short-circuited conductors imbedded near the periphery of cylinder built up of thin circular discs of iron.

The stationary part of the motor is called the *stator*, and the rotating part the *rotor*. The currents in the stator produce a rotating magnetic field which induces currents in the rotor conductors, the effect being a tendency on the part of the rotor to follow the rotating field.

25. Suppose that each circuit in the stator consists of N_1 turns of wire, and each rotor circuit of N_2 turns, and let the resistance and reactance of each stator circuit be r_1 and s_1 respectively, and of each rotor circuit when at rest r_2 and s_2, and let the E.M.F. induced per turn in the stator coils be e.

If ω_1 and ω_2 are the angular velocities of the rotating field and rotor respectively, and the frequency of the current i_1 in a stator coil be n, then the frequency of the currents i_2 in the rotor coils will be

$$\frac{\omega_1 - \omega_2}{\omega_1} \cdot n$$

or, putting σ for $\frac{\omega_1 - \omega_2}{\omega_1}$,

the frequency of the rotor currents is $\sigma\, n$.

σ is frequently called the "slip."

(We will suppose that E.M.Fs. and currents have their root mean square values.)

It follows that the E.M.F. induced per turn in the rotor coils is $\sigma\, e$. The E.M.F. induced in each circuit of the rotor coils is therefore given by

$$\mathrm{E}_2 = \sigma\, \mathrm{N}_2\, e \qquad (37)$$

and the vector E.M.F. equation is

$$r_2\, i_2 + k\, \sigma\, s_2\, i_2 = \sigma\, \mathrm{N}_2\, e$$

the reactance when in motion being $\sigma\, s_2$. Thus

$$i_2 = \frac{\sigma\, \mathrm{N}_2\, e}{r_2 + k\, \sigma\, s_2} = \frac{\sigma\, \mathrm{N}_2\, e\, (r_2 - k\, \sigma\, s_2)}{r_2^2 + \sigma^2 s_2^2} \qquad (38)$$

The power spent per circuit in heating the rotor is then the scalar product of (37) and (38), that is

$$\text{power wasted} = \frac{\sigma^2\, \mathrm{N}_2^2\, e^2\, r_2}{r_2^2 + \sigma^2 s_2^2} \qquad (39)$$

26. Again, the E.M.F. induced in each stator circuit due to the rotating field is given by

$$\mathrm{E}_1 = \mathrm{N}_1\, e. \qquad (40)$$

* See also "Theory of the General Alternating Current Transformer," by C. P. Steinmetz, *Transactions* American Institute Electrical Engineers, 12, pp. 351—365, 1897, and "Alternating Current Motors," by W. G. Rhodes, M.Sc., ELECTRICAL REVIEW, Vol. 37, pp. 599-600, 1895, and Vol. 38, pp. 139—142, 1896.

Also, the current i_1 in the stator consists of two parts, the function of one part, i_1', being to excite the stator and produce the rotating field, and that of the other part i_1'' to transmit energy to the rotor.

But

$$i_1'' = -\frac{\mathrm{N}_2}{\mathrm{N}_1}\, i_2 = -\frac{\sigma\, \mathrm{N}_2^2\, e\, (r_2 - k\, \sigma\, s_2)}{\mathrm{N}_1\, (r_2^2 + \sigma^2 s_2^2)} \quad \ldots \text{(by equation (38))} \qquad (41)$$

The power transmitted per circuit to the rotor is, therefore, the scalar product of the vectors

$$-\mathrm{N}_1\, e \text{ and } -\frac{\sigma\, \mathrm{N}_2^2\, e\, (r_2 - k\, \sigma\, s_2)}{\mathrm{N}_1\, (r_2^2 + \sigma^2 s_2^2)},$$

that is,

$$\text{Power transmitted to rotor} = \frac{\sigma\, \mathrm{N}_2^2\, e^2\, r_2}{r_2^2 + \sigma^2 s_2^2}. \qquad (42)$$

The output, P, of the motor is then obtained by subtracting (39 from (42), that is

$$\mathrm{P} = \frac{\sigma\, \mathrm{N}_2^2\, e^2\, r_2}{r_2^2 + \sigma^2 s_2^2} - \frac{\sigma^2\, \mathrm{N}_2^2\, e^2 r_2}{r_2^2 + \sigma^2 s_2^2} = \frac{\mathrm{N}_2^2\, e^2\, r_2\, \sigma\, (1 - \sigma)}{r_2^2 + \sigma^2 s_2^2} \qquad (43)$$

27. To find the torque T exerted per circuit on the rotor, we must divide the output P by the angular velocity ω_2, but

$$\sigma = \frac{\omega_1 - \omega_2}{\omega_1},$$

therefore

$$\omega_2 = \omega_1\, (1 - \sigma)$$

that is

$$\mathrm{T} = \frac{\mathrm{N}_2^2\, e^2\, r^2\, \sigma}{\omega_1\, (r_2^2 + \sigma^2\, s_2^2)}. \qquad (44)$$

This expression gives the torque in terms of the slip, the resistance and reactance of the rotor coils, the E.M.F. developed per turn by the rotating field at full frequency, the number of turns per section on the rotor, and the angular velocity of the rotating field.

The relation between torque and slip is shown graphically in fig. 11.

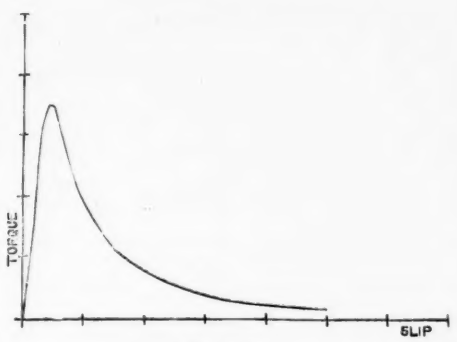


FIG. 11.

Equation (44) shows the starting torque is (putting $\sigma = 1$)

$$\mathrm{T}_0 = \frac{\mathrm{N}_2^2\, e^2\, r_2}{\omega_1\, (r_2^2 + s_2^2)},$$

which is greater the less the reactance of the rotor bars, and the less the angular velocity of the rotating field.

To give a large torque the E.M.F. induced per turn by the rotating field should be large, that is, the air-gap should be as small as possible and leakage should as far as possible be avoided.

THE MONOPHASE INDUCTION MOTOR.

28. In the foregoing theory it has been assumed that the rotor bars are cut by a magnetic field rotating at a uniform velocity ω_1. So long that this condition is satisfied the number of independent currents in the stator does not affect the theoretical treatment of the problem. When, however, the stator is fed by one alternating current only, the conditions of the problem are altered. The resultant alternating field now preserves a constant direction relative to the stator. We can, however, regard this resultant field as compounded of two uniform magnetic fields rotating with equal angular velocities but in opposite directions round the stator.

29. Suppose, now, that the rotor is started in either direction by any means whatever and let the "slips" relative to the two rotating fields be σ_1 and σ_2 respectively, so that $\sigma_1 + \sigma_2 = 2$, and $\sigma_1\, \sigma_2 < 1$ (except at start when it equals unity).

If the rotor is started in the direction such that $\sigma_1 < 1$, it will, by (44) be subject to a torque

$$\mathrm{T}_1 = \frac{\mathrm{N}_2^2\, e^2\, r_2\, \sigma_1}{\omega_1\, (r_2^2 + \sigma_1^2\, s_2^2)}$$

tending to diminish σ_1, and a torque

$$\mathrm{T}_2 = \frac{\mathrm{N}_2^2\, e^2\, r_2\, \sigma_2}{\omega_1\, (r_2^2 + \sigma_2^2\, s_2^2)}$$

tending to increase σ_1 and diminish σ_2. The resultant torque in the direction of σ_1 diminishing is

$$T_1 - T_2 = \frac{N_2^2 e^2 r^2}{\omega_1} \left\{ \frac{\sigma_1}{r_2^2 + \sigma_1^2 s_2^2} - \frac{\sigma_2}{r_2^2 + \sigma_2^2 s_2^2} \right\}$$

$$= \frac{N_2^2 e^2 r_2}{\omega_1} \frac{(\sigma_2 - \sigma_1)(\sigma_1 \sigma_2 s_2^2 - r_2^2)}{(r_2^2 + \sigma_1^2 s_2^2)(r_2^2 + \sigma_2^2 s_2^2)}. \quad (45)$$

30. Equations (44) and (45) bring out clearly the difference between the actions of multiphase and monophase induction motors. A multiphase motor will run up to synchronism with the rotating field before the torque vanishes, and its value is a maximum for variations of σ when $r_2^2 - \sigma^2 s_2^2 = 0$. In a monophase motor, however, the torque is zero when $\sigma_2 = \sigma_1$ (at start), and again when

$$\sigma_1 \sigma_2 s_2^2 - r_2^2 = 0,$$

that is, when

$$\sigma_1 \sigma_2 = \left(\frac{r_2}{s_2}\right)^2,$$

or

$$\sqrt{\sigma_1 \sigma_2} = \frac{r_2}{s_2} \quad (46)$$

which shows that every monophase induction motor has, for a given frequency of the current, a speed peculiar to itself beyond which it cannot go, and this speed is determined by the ratio of the resistance to the reactance of the rotor windings.

Equation (45) also shows that unless s_2 is greater than r_2, the motor will not run at all, because the product $\sigma_1 \sigma_2$ being necessarily less than unity in whichever direction the motor is started, there would be a torque in the opposite direction.

31. Whereas, then, the multiphase motor can possibly approach to synchronous running with the rotating magnetic field, if the load were made sufficiently small, a monophase induction can never go beyond the limit set (see (46)) by its own resistance and reactance, and will thus, under the most favourable conditions, have a speed less than that corresponding to synchronism with the supply current.

32. With regard to the representation of root mean square (R M S) values by vectors, and interpreting results deduced from vector equations as if the quantities represented R M S values, we can only say that it is often convenient to take R M S instead of maximum values, more especially since for most purposes we can take any periodic E.M.F. or current curve and proceed to make calculations as if the actual curve was replaced by a simple harmonic curve having the same periodic time and the same R M S value, and if we give to a vector a magnitude to represent the R M S value, and a suitable phase positions, we shall accurately interpret any results involving only *scalar products*.

33. The simplicity of vector calculations in alternating current problems and the ease with which the method may be taught to students whose mathematical knowledge is of an elementary nature renders the teaching of a difficult subject much less laborious; and we think that the sooner young electricians know that much may be learnt of the theory of alternating currents without a previous arduous mathematical training, the sooner will a greater interest be aroused in what is perhaps the most fascinating branch of physical science.

34. In conclusion I may add that the foregoing theory, most of which is not elsewhere obtainable, may be understood by any reader possessing only a knowledge of a little trigonometry and of algebra up to quadratic equations, on taking for granted Propositions 1, 2, and 3 of Section 9. These, together with Sections 6 and 7, are the keynotes of the whole method which I have applied to a few of the more prominent problems of alternating currents. When these are thoroughly understood, it should be an easy matter to adapt the method to most problems which may arise.

CORRIGENDUM.

I regret that there is an algebraical error in Section 22 (second article). As the slip affects the final result I have completely rewritten that section. My thanks are due to Mr. Alexander Russell, M.A., for very kindly drawing my attention to the error in a private letter.

22. In this case the vector equations to be solved are

$$\left.\begin{aligned} (r_1 + k s_1) i_1 + k p M_{12} i_2 &= e \\ k p M_{21} i_1 + (r_2 + k s_2) i_2 &= e \end{aligned}\right\} \quad (23)$$

and

$$i = i_1 + i_2$$

whence, on putting $M_{12} = M_{21} = M$

$$\left.\begin{aligned} \{r_1 r_2 - s_1 s_2 + p^2 M^2 + k (r_1 s_2 + r_2 s_1)\} i_1 &= \{r_2 + k (s_2 - p M)\} e \\ \{r_1 r_2 - s_1 s_2 + p^2 M^2 + k (r_1 s_2 + r_2 s_1)\} i_2 &= \{r_1 + k (s_1 - p M)\} e \end{aligned}\right\}$$

Putting for shortness

$$\left.\begin{aligned} r_1 r_2 - s_1 s_2 + p^2 M^2 &= P \\ r_1 s_2 + r_2 s_1 &= Q \end{aligned}\right\}$$

and

these equations become

$$\left.\begin{aligned} (P + k Q) i_1 &= \{r_2 + k (s_2 - p M)\} e \\ (P + k Q) i_2 &= \{r_1 + k (s_1 - p M)\} e \end{aligned}\right\} \quad (23a)$$

which by multiplying both sides of the equations by $P - k Q$, and simplifying, may be written

$$\left.\begin{aligned} (P^2 + Q^2) i_1 &= [P r_2 + Q (s_2 - p M) + k \{P (s_2 - p M) - r_2 Q\}] e \\ (P^2 + Q^2) i_2 &= [P r_1 + Q (s_1 - p M) + k \{P (s_1 - p M) - r_1 Q\}] e \end{aligned}\right\} (24)$$

These are the vector current equations giving the components of i_1 and i_2 along and at right angles to e. By addition we have

$$\left.\begin{aligned} (P^2 + Q^2) i = \\ [P (r_1 + r_2) + Q (s_1 + s_2 - 2 p M) + k \{P (s_1 + s_2 - 2 p M) - Q (r_1 + r_2)\}] e \end{aligned}\right\} (25)$$

which gives the components of the main current along and at right angles to e; thus the component in phase with e is

$$\frac{P (r_1 + r_2) + Q (s_1 + s_2 - 2 p M)}{P^2 + Q^2} \cdot e,$$

and the component at right angles to e, or the wattless component, as it is called, is

$$\frac{P (s_1 + s_2 - 2 p M) - Q (r_1 + r_2)}{P^2 + Q^2} \cdot e.$$

Multiplying and dividing the right-hand side of equation (25) by

$$P (r_1 + r_2) + Q (s_1 + s_2 - 2 p M) - k \{P (s_1 + s_2 - 2 p M) - Q (r_1 + r_2)\},$$

we get, after some reductions,

$$i = \frac{\{(r_1 + r_2)^2 + (s_1 + s_2 - 2 p M)^2\} e}{P (r_1 + r_2) + Q (s_1 + s_2 - 2 p M) - k \{P (s_1 + s_2 - 2 p M) - Q (r_1 + r_2)\}},$$

which shows that the equivalent resistance, R, and reactance, S, of the parallel circuit are given by

$$\left.\begin{aligned} R &= \frac{P (r_1 + r_2) + Q (s_1 + s_2 - 2 p M)}{(r_1 + r_2)^2 + (s_1 + s_2 - 2 p M)^2} \\ -S &= \frac{P (s_1 + s_2 - 2 p M) - Q (r_1 + r_2)}{(r_1 + r_2)^2 + (s_1 + s_2 - 2 p M)^2} \end{aligned}\right\} \quad (26)$$

and the equivalent impedance, I, is given by

$$I^2 = R^2 + S^2 = \frac{P^2 + Q^2}{(r_1 + r_2)^2 + (s_1 + s_2 - 2 p M)^2},$$

or, putting in the values of P and Q,

$$\left.\begin{aligned} R &= \frac{(r_1 + r_2)(r_1 r_2 - s_1 s_2 + p^2 M^2) + (s_1 + s_2 - 2 p M)(r_1 s_2 + r_2 s_1)}{(r_1 + r_2)^2 + (s_1 + s_2 - 2 p M)^2} \\ -S &= \frac{(s_1 + s_2 - 2 p M)(r_1 r_2 - s_1 s_2 + p^2 M^2) - (r_1 + r_2)(r_1 s_2 + r_2 s_1)}{(r_1 + r_2)^2 + (s_1 + s_2 - 2 p M)^2} \\ I^2 &= \frac{(r_1 r_2 - s_1 s_2 + p^2 M^2)^2 + (r_1 s_2 + r_2 s_1)^2}{(r_1 + r_2)^2 + (s_1 + s_2 - 2 p M)^2}. \end{aligned}\right\} (27)$$

AMBROIN.

[COMMUNICATED.]

AMONG the various insulating materials which, besides ebonite, vulcasbest, porcelain, and slate, have from time to time made their appearance, ambroin is well worth consideration by electrical engineers, and during the short period of its existence the many advantages it presents to the electrical industry, have caused it to be highly appreciated by all who, from practical experience, are in a position to judge.

Ambroin is composed of fossil copal and silicates, and the silicates are saturated and mixed with the copal by a patent process in such a manner that, after being subjected to a very great pressure, an exceedingly strong, firm, uniform, and non-hygroscopic material is produced. By varying the proportions of the component parts a number of qualities, to meet all possible requirements that can be demanded of an insulator, are manufactured, and, for example, the fireproof quality contains only a sufficient quantity of copal to ensure the adhesion of the mass and to destroy the water-absorbing capacity of the silicates.

A short summary of the qualities of ambroin may be of interest.

After being subjected to pressure ambroin does not undergo any variation in volume, and, in consequence, the most complicated pieces can be very accurately moulded. This is of special importance where the insulation consists of several parts, as all the parts are interchangeable, and portions which are particularly subjected to wear can be easily replaced. Screws can be moulded in ambroin and do not require any further cutting to ensure accuracy.

Ambroin, even in the open air, does not absorb moisture, in which it differs from most other materials, and this not only greatly increases its value as an insulator, but there is no danger of the destruction of the insulation owing to the water taken up freezing in the winter. To illustrate the relative amount of water absorbed by various materials we give the following comparison. Pieces of equal size and with a smooth surface were taken, and after being immersed in water at 75° C. for 1½ hours the increase in weight was:—

1.	Ambroin	0·32 per cent.
2.	"Aetna" material (the surface became rough)	3·17 ,,
3.	Stabilit	1·41 ,,
4.	Vulcasbest	4·80 ,,
5.	Vulcanised fibre	24·5 ,,

Dielectric strength according to tests of the Reichsanstalt, Berlin:—

(1) A dry sheet 0·34 mm. thick was *not* pierced with 5,000 volts.

(2) A sheet 5 mm. thick, after lying in a room containing 40 per cent. moisture, was *not* pierced with 36,000 volts.

The *insulation resistance* of dishes 3 mm. thick with 200 volts:—
(1) Without preparation was 200,000 megohms.
(2) The dish was half filled with sulphuric acid, 26° Bé, covered up and subjected to a temperature of 49° C. for 10 days. After a superficial drying with blotting paper the resistance was the day following 150,000 megohms, and two days later 200,000 megohms.

In view of the great importance of mechanical strength in an insulating material, especially when used for traction work, a comparison between ambroin and other substances should prove instructive. For the purpose of the compression tests 1-in. cubes of ambroin and ebonite were taken, which presented a surface of 1 sq. in. to the pressure.

At normal temperature the destruction of the ambroin cube took place under a load of 2,688 lbs., and of the ebonite cube under a load of 2,198 lbs.

At 60° C. the ambroin cube withstood the pressure up to 1,958 lbs., while the destruction of the ebonite cube begins under a very small load.

To test the *tensile strength*, rods of equal dimensions were taken, and at normal temperature the breaking strain was:—

For ebonite...	1,088	lbs. per	sq. in.
„ aetna material	1,350	„	„
„ ambroin	2,082	„	„

At 60° C. ebonite stretched extensively, while the tensile strength of ambroin is even greater than at ordinary temperature.

The ordinary quality of ambroin does not begin to burn until subjected to a temperature of 400° C., while the special quality, made for switchboards, &c., withstands the hottest zone of a bunsen flame (1,700° C.) for some considerable time, and this quality can, therefore, be used in all cases where, owing to short circuits, sparking causes a momentary great heat. Of other materials, ebonite and celluloid soften in water at a temperature of 70° C., celluloid burns readily at 110° C., ebonite at 180° C. and stabilit cracks when subjected to heat.

Ambroin, quality S, withstands the action of sulphuric acid, 45° Bé., up to a temperature of 80° C. and of concentrated hydrochloric acid, and this quality is well adapted for battery boxes, while a special quality which is not attacked by alkalio or chlorine is made for electro-chemical purposes.

Ambroin does not contain sulphur or any other oxidising substances.

The uses to which ambroin may be put include the insulating parts of dynamos, electromotors, and transformers, as Brush insulators, commutator rings, transformer bobbins, &c., also accumulator boxes, while plates for resistances and switchboards, either with contact studs complete or with holes moulded in to screw down the contact pieces, deserve special attention. Ambroin overhead insulators for tramways have been used on many of the principal lines on the Continent with satisfactory results, and it is particularly adapted for motor cars, in fuse boxes, spark arresters, switchboards, switches and controller insulation. For the last named a special quality is made, which combines high insulation with resistance against the action of sparking, and which is evenly and firmly pressed on to the controller axle.

REPAIRING A "BURNT-OUT" COMMUTATOR.*

By NORMAN H. CROWELL.

IF the dynamo-tender understands his business and has suitable instruments at hand, it may be but a matter of a few minutes' time to discover the cause of a "breakdown" and set about its repair. If, however, he happens to be a good steam engineer, but a novice at the practice of the electrical art, and tends dynamo by "throwin' her in gear" and trusting to luck, he may as well sit calmly down and wait for reinforcements.

Under the supervision of a competent electrician, a serious breakdown is of rare occurrence. There can be little trouble with the machine with a firm foundation, steady power, tight screws, evenly ground brushes, and the constant application of a good big "rag" to the parts where dirt, grease and copper dust collect.

In the case in hand the dynamo had gone on for months grinding out its existence with no attention from the tender. He never knew whether the brushes bobbed, the commutator cut or sparked, or where to oil the journals. This state of things could not continue long without something giving way, and the lights suddenly winked out one night leaving Mr. Engineer "up a stump."

By the aid of a dim and flickery lantern we hastily inspected the dynamo, field-magnet, wall attachments, ground wire and even the friction clutch. As far as could be seen everything was tight and in order. Now we must roll up our sleeves and hunt for the "trouble." A small boy eagerly grasps the opportunity to turn the "magneter" handle while we poke around feeling for shocks, and we find a good many.

Everything is found all right until we test the exciter, and here we find a grave condition of things. By placing one wire against a segment of the commutator and the other firmly against the end of the armature shaft, we get a merry tinkle from the bells. By testing the segments one by one we discover that about every third one is in connection with the shaft. We have located the difficulty, and now proceed with the treatment.

We first remove the armature from its chamber, and by testing it again we prove our theory to be the right one. Then we make out a little list of articles needed and send the small boy away with it. The list reads as follows: Twenty pieces of heavy mica, 4 × 5 ins.; can of shellac and brush; strip of heavy duck cloth, 6 ins. wide; needle and saddler's thread.

While he is in quest of these things, we place the armature in the lathe to facilitate matters, and unscrew the burr that holds the cap over the ends of the commutator segments. Next, we remove the "cap," and the cause of the short-circuit is visible to the eye. In several spots the thick mica layers are charred through, and when we peel them off we find the copper has a "worm-eaten" appearance.

Take a flat file and cut through the band of wires about the armature head. If the cover is badly worn or torn, file both bands and take the cover off entirely, saving the eyes for use on the new cover. This exposes to view the 20 pairs of wires leading from the armature to the lugs of the segments. Now comes the delicate task of spreading the segments. It is delicate for the reason that they are worn to the thinness of an ordinary pasteboard and require careful handling. However, by pulling gently with the pincers they are lifted from their bed and the charred insulation is scraped and blown away.

At this point, we test the connections between the armature wires and the lugs and find them good. Now carefully inspect the insulation of the base-cap, and if you find it unimpaired, proceed to the laborious task of cutting the mica into strips.

These strips we make ½ inch wide, 4 inches long, and cut one end off at an angle of 45°. Care must be taken to keep the mica from flaking, otherwise you will be greatly hindered in the work to follow. After enough strips are cut, we lay them in a place convenient to our reach and turn our attention to the dismantled commutator. Make sure that no small pieces of insulation adhere to the segments, and then carefully return them to their original position. Slip a heavy rubber band over their base to keep them in their place.

Now we insert the shaft in a vice, with the commutator end uppermost, giving us the most convenient position for handling the ticklish job we now undertake. The next step is to put a strip of the mica between each segment and its fellow, making sure that the pointed end fits the V-shaped recess in the base-cap closely. Take a strip and swab it with shellac, then gently pry two segments apart and slip in the strip. The job increases in difficulty as it nears completion.

A small wooden mallet may be used to tap the strips down into place, and this is the place to exercise patience as long as possible.

Now, with the task half done, the mica strips stick out ¼ in. from the normal surface of the commutator, and should project at least an inch beyond the ends of the segments. The ends that thus project are now carefully clipped off close to the segments with a pair of sharp shears, care being taken to make good clean cuts. When this is done, drop the mica ring behind the strips to hold them from the shaft. Now take an extra thick and fine sheet of mica, and cut out a circular piece with a hole in the centre. This is to take the place of the old insulation on the "cap," and must fit accurately, and be thick and solid.

Fit this ring to the cap and put the cap on the shaft in position. Now start on the burr. Unless you have access to a special vice for holding the cap firm, it will be very liable to turn, thereby twisting the segments out of position and perhaps destroying the insulation. This must be avoided, but the burr must be set on so tightly that there will be no probability of its loosening, although the direction of the armature's rotation may tend to unscrew it, which is unfortunately the case with many machines.

* *American Electrician.*

With the cap and burr in place, we proceed to remove the superfluous mica that confronts us. This is done best with a very sharp knife point. When the most of it has been cut and pared away with the knife, take the file and finish it.

Now, if you have succeeded in getting the commutator round or approximately so, you may be assured that your job has been well done, but if it presents an oval shape or a very uneven surface, you will probably have the pleasure of going over the whole process again. If it is oval the brushes will bob and dance until the bulging part wears thin and caves in. If uneven, the chances are that it will not permit lathing, and you may have to loosen the burr and spend an hour adjusting it. The commutator should be so nearly circular that a small amount of light filing will complete it.

Having removed the rubber band, you are ready to put on the drum or canvas coating on the armature head. It is a good idea to have some one who is handy with tools attend to the making of a duplicate of the old cover, which is a simple matter, while you are engaged on the other work. Wrap the cover tightly around the head and sew with the saddler's thread. Put on a liberal coat of shellac. Then cut some long strips of medium thin mica to support the band wires. Next wrap some No. 16 (B. & S.) wire around the edge of the drum over the strips of mica at a strong tension. Make a band about ½-in. wide and solder in several places. Care must be taken that no part of the cover or solder bulges out so that it will touch the chamber when the armature is placed in position.

Now everything is completed, and you are ready to slip the armature back into its chamber, adjust the brushes and start up. It will take a minute for the magnet to pick up, but if you have been thorough in your work you will have the satisfaction of seeing the pointer begin to dance, and when you turn the handle, realise that you have saved your company time as well as expense.

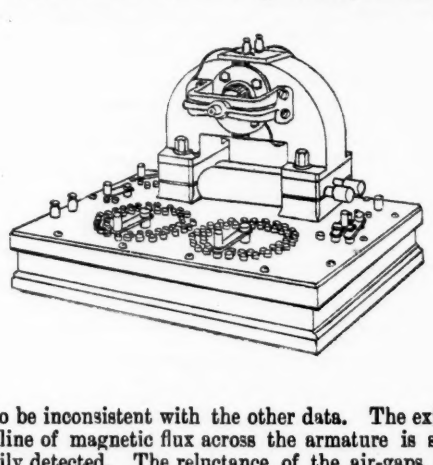
A MAGNETIC TESTING INSTRUMENT.

Messrs. R. B. Treat and S. W. Esterline, of Purdue University, Lafayette, Ind., have recently published a description of a piece of apparatus for testing samples of iron, which presents some features of interest, though no new principle of construction is involved. The general arrangement of the apparatus is shown in the figure. Two bars under comparison are clamped side by side, in holes turned to fit them, in heavy blocks of very soft iron. Round the bars are ebonite bobbins or spools, wound with copper wire, and a closely fitted slot-wound dynamo armature is run at a high known speed, presumably by a motor, in a gap between the blocks. The dynamo brushes are connected to a Weston voltmeter, so that only a very small current is taken from the armature, and the readings of the voltmeter are directly proportional to the flux through the armature.

The instrument can be used in two ways. In one the magnetising currents in the bobbins on the two bars may be adjusted, so that the fluxes in the two bars are equal, and opposite in direction. When this is the case, there will be no flux through the revolving armature, and the voltmeter will show no difference of potential between the brushes. If one bar, whose magnetic properties are previously ascertained, be used as a standard of reference, and the magnetising force of the current round it carried through any range, then by continually adjusting the magnetising force acting on the other bar, so as to give no deflection on the voltmeter, a continuous comparison between the properties of the two bars is obtained.

Another way of using the instrument is to remove one bar, and use the revolving armature and voltmeter to measure the flux through the iron circuit, as the magnetising force on the bar is continuously varied. By these means the hysteresis cycle of the specimen, or its B.H. curve, can be determined.

The dimensions of the test bars are 10 inches long, 4 π cm. between the yokes, and ·575 inch in diameter. The bobbins on the test bars are wound with 100 turns of wire, capable of carrying 10 amperes, giving a possible magnetising power of 1,000 ampere-turns. The two coils are connected in series, and switches are arranged by which the number of active turns on the two bobbins can be varied. In any case the ratio between the number of ampere-turns on the two bars is equal to the number of active turns. The number of turns on the bobbin round the bar which is intended to be used as a standard of reference, may be either 50, 75, or 100, while the number on the other bar may be anything from 1 to 100. The two switches seen in front of the magnetic parts change the number of turns on one magnetising coil, and are arranged to insert an equivalent resistance as each turn is cut out, so as to keep the resistance of the circuit unaltered. The armature has 7,000 turns, laid in 40 slots, and is driven at 4,000 revolutions per minute. With a flux density of 17,000 lines per square cm. through one bar, an E.M.F. of 90 volts is said to be generated, but this figure



seems to be inconsistent with the other data. The existence of one line of magnetic flux across the armature is said to be readily detected. The reluctance of the air-gaps at the dynamo armature is small, owing to the close fitting, and the areas of the clamped joints are 32 times the section of the bar.

An instrument of this kind, in which the magnetic flux through a bar can be continuously varied and measured on a direct reading instrument, offers great convenience in comparison with the method of obtaining the flux as the sum of a number of small increments measured separately by the throws of a ballistic galvanometer. The design is however, open to obvious objections. For instance, the method of changing the magnetic force in the bar by cutting out turns may be objected to on the ground that the distribution of force is varied as well as its total intensity, a defect that would not occur if the current were reduced or increased. Again, the behaviour of a bar kept in a state of tremor by the vibration of an armature would be different from its behaviour when unshaken. But for the use of engineers such objections are readily overbalanced by considerations of convenience, and we have no doubt from its description that the apparatus might be exceedingly valuable. A good deal of information about the arrangements for clamping the test bars, and other points of detail, is given in an article in the *Electrical World* of New York, December 11th, 1897, to which we may refer our readers.

THE TELEGRAPH TROUBLES.

The Clerks' Point of View.

By CHAS. H. GARLAND.

The case of the telegraph clerks has suffered in the past, because of the difficulties besetting a clear statement of their position. Documents have been prepared which have been summarised by the newspapers of the country, and garbled in the summary. Members of Parliament, unacquainted with the technicalities of Government employment, have attempted, with the most laudable intentions, to explain the complaints to the House of Commons. The result has been a misunderstanding. Public functionaries and trade-union officials have always failed to grasp the peculiar *milieu* of a civil servant and his limitations; and the class papers are

read only by the class affected. Again, considerable public attention is attracted only during periods of great excitement, and newspapers, eager for exclusive news of a sensational character, have over-emphasised or mis-stated minor points, to the utter exclusion of the more important issues. The association of last year's movement, with a strike against the performance of overtime, reasonable or unreasonable, is an instance of how far misconception and misrepresentation can go. The main point in dispute was the violation of certain rights in the matter of promotion. I therefore welcome the opportunity afforded me by the editors of the ELECTRICAL REVIEW to summarise our point of view on the principal claims of the postal telegraph clerks.

There are certain general principles underlying the whole of our movement which are, from time to time, attacked by the representatives of the Department, and the organs that range themselves on their side. As agreement with these principles is the necessary presupposition of any sympathy with our claims, it would perhaps be well to deal with them before attacking these details. A criticism of our opponents will make our position clear.

It is seriously contended that, provided the salary and prospects remain the same as they were some 16 years ago, the staff should be content there being no ground for complaint. It will be my aim to prove that in the case of a large section of postal employés the prospects have actually deteriorated during the past 16 years, but meanwhile I will draw attention to this principle of departmental economy, and offer a few reasons against it. It is neatly stated in a letter from Sir S. Walpole to a Mr. Newton, dated August 31st, 1897: "The prospect of obtaining £190 a year to which reference was made in the Civil Service Commissioners' Circular issued between 1880 and 1891 . . . . still remains, and as the proportion of superior appointments, including senior telegraphists, in the number, to the total number of the staff is almost exactly the same as it was at the date of Mr. Fawcett's revision (1881) whatever prospect a young man had at that time of obtaining promotion to the higher classes he enjoys now." This argument may be called the justification of standing still, and is entirely opposed to any desire for progress. The other general objections to our movement have been stated in various quarters, notably by Mr. Lewin Hill (assistant secretary G.P.O.) in his evidence before the Tweedmouth Committee on March 23rd, 1896. The same views have been crudely summarised by the *Times* so recently as December 29th, 1897, and are tersely expressed in all their native ugliness in the following sentences from a leader of that date:—"It may be suggested to them (the telegraph clerks) that they still possess the right to resign positions which do not suit them. The Government has no difficulty whatever in finding plenty of candidates for vacancies, and so long as that is the case it has no occasion to raise its terms. It is not difficult to become a telegraph clerk of average utility, and there are any number of people quite ready to accept the present conditions of service." These arguments may be described as the right to resign, which, in the case of old clerks, is also the right to starve, and the right of the State to "sweat."

Let us look, first, at the justification for standing still. The Government should be, "in the first flight of employers," a Cabinet Minister said in the House of Commons. Mr. Arnold Morley, when Postmaster-General, declared that the State should be "the model employer." If the Government is to set the example to other employers, should it stand still in the midst of a general progression? Yet this is what it has done, if it has left the pay and prospects of its employés identically the same as in 1881. Take a rapid glance at two recently published reports of the labour department of the Board of Trade. The report of Mr. Burnett, the chief labour correspondent, upon the strikes and lock-outs of 1896, shows that for several years there has been a notable upward tendency of wages. The Fourth Annual Report of the Board of Trade (1896-7) shows conclusively that while the hours of work are on the decrease, there is a distinct increase in the wages paid. A few figures from the latter document will clearly illustrate this. Taking the class described as "Employés of public authorities" as illustrating the general tendency, and approximating somewhat in terms of service to the civil servant, we find that the "average amount of decrease in weekly hours of labour (per head of those affected") is stated as follows:—

1893.	1894.	1895.	1896.
4·49	4·02	5·32	2·65

During the same period, the "net effect of changes on weekly wages [(+) = increase (−) = decrease]" is given for the same class in the following figures:—

Amount per head of those affected:

1893.	1894.	1895.	1896.
+ 1·6¾	+ 1·5¾	+ 1·7¼	+ 1·2½

We will suppose that the pay and prospect offered after the revision of 1881 were based upon some consideration of the market value of the work at that period, and we will bear in mind that the market value of the work is affected by the standard of living of the class performing the work. This standard of living may be raised, and it is a commonplace of economics that the luxuries of one generation become the necessaries of another. Again, the cost of maintaining an equal standard of living may be increased by a rise in price of the necessaries of life. The latter eventuality has undoubtedly happened in London. The cost of living has increased. To take only one important factor. The average rise of London rent (on unaltered buildings) since 1870 has been £304,634 per annum, or 1·03 per cent. on the average valuation. The homes of Londoners have been driven farther and farther from the centre by the increase in the commercial importance of the City; the hours have been lengthened by the railway journey, and the cost of living has been increased by the daily railway fare. To take only this one instance of the increase in cost, without discussing the large increase in the cost of meat and other things, we see that even if the standard of living had remained the same as in 1881, the relative value of the pay and prospects offered to telegraph clerks has decreased. Meanwhile, however, it has been the constant endeavour of public organisations to raise the standard of living of all classes by the multiplication of educational and other facilities. Undoubtedly these efforts have been crowned with some measure of success. Leaving aside the question of whether the pay and prospects of telegraph clerks have retrograded, it is obvious that for a Government to plume itself on being a model employer because it has stood still during 16 years of progress is a sheer absurdity. If telegraph clerks ask that better pay and prospects should now be given than were offered in 1881 they are merely pressing the Government to move with the times and take its proper place among "the first flight of employers."

The "right to resign" is offered to those who, under pressure of changing environment, feel that the conditions of service are not what they should be. By the time a boy has become a good telegraph clerk, despite the *Times*, he has spent a sufficient period in the service to be too old for commencing in another profession. His whole training has been directed to fitting him for the keen competitive examination which he has to pass, and has consequently unfitted him for any other employment. At 16 years he enters the Post Office full of hope, but with all the irresponsibility of youth. He is little troubled with prospects. He fondly thinks they are assured. Youth is essentially unreflective, and it is not till he has passed some four or five years in postal service, and has left the parental nest, that he begins to realise his cruel disillusionment. Then he is offered the right to resign; and then he feels he cannot accept it. On the principle that half a loaf is better than none, he hangs on, and by means of overtime and careful management, perhaps succeeds in getting through the years that divide him from a salary he can live on. With only the prospect of throwing himself on an overcrowded labour market, having spent the best years of his life in acquiring a trade of which the Post Office has a monopoly, he feels he cannot use the "right to resign," which is so freely offered to him. So there are relatively few resignations. But he has another right. He has the right possessed by all citizens to look to the Government not to exploit his weakness, and to call upon the State to become, in reality, the "model employer." Where any prospect of placing his special knowledge is opened up, the Government employé is quick to take advantage of it. The *Cables Recorder*, a Valparaiso paper, of May, 1895, said, speaking of the staff of the Commercial Cable Company:—"The company's success can be attributed not a little to the splendid working staff who are chiefly from the British Postal Telegraph Service." This may be said of all the cable companies.

Really one can hardly accept the supposition that because relatively few telegraph clerks resign, a veritable Utopia must exist in the Postal Telegraph Service.

The other contention is that, so long as clerks can be obtained at the present salaries, there is no need to raise the terms. By a parity of reasoning, it might be contended that because women working upon the making of match boxes for over 100 hours per week could be obtained for a wage of 4s. weekly, there was no need to raise the terms. Or because London seamstresses can be induced to starve on a wage of 12s. for a week of 70 hours, they are well paid. Because 150 persons apply for a post as foreign correspondent at 30s. a week, does it prove that 30s. is an adequate remuneration? This is commonly known as the sweater's argument. It was while such unenlightened principles guided the commercial world, that the "Song of the Shirt" was written. It is against such principles that all recent labour legislation has been directed, and against the application of such principles to State employment, it is the duty of all Englishmen to fight.

I thought it well before entering on the more detailed exposition of our claims, to deal with these general principles. Telegraph clerks feel that the Government should indeed be among the first flight of employers, and one of the duties of intelligent Government should be to keep its own servants abreast of the times. That they have not retrograded in 16 years, whilst all the rest of the world has progressed, is not a cause for satisfaction, self-congratulation, or pride. That they have not progressed is rather a cause for shame. To fall back on the effete principles of an inhuman political economy to justify parsimony, is unworthy of a model employer. The duty of the State is rather to show an example of humane dealing to even its most insignificant employé, and thus constitute itself a model which other employers can copy, to the benefit of justice, humanity and progress.

(*To be continued.*)

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1898.

[*Compiled expressly for this journal by* W. P. Thompson & Co., *Electrical Patent Agents*, 322, *High Holborn, London, W.C., to whom all inquiries should be addressed.*]

16. "Improvements in the manufacture of diaphragms for electrolysis." J. W. Towers. Dated January 1st.

26. "An improved construction of and method and means of laying underground electrical cables or conductors." T. F. J. Truss. Dated January 1st.

45. "Electric switch apparatus for railways to enable train to receive currents from signal station when in contact with its electric current conductor (especially useful during fog)." W. T. Brain. Dated January 1st.

58. "Improvements in rail joints for electric railways." M. Barschall. Dated January 1st.

67. "An improvement in holders for electric glow lamps." H. C. Gover, C. F. Proctor and W. G. Pipkin. Dated January 1st. (*Complete.*)

80. "Improvement in electrical advertising devices." G. A. Lesieur. Dated January 1st.

121. "Improvements in electric meters." E. Batault. Dated January 3rd.

122. "Improvements for separating stable or other salts and generating electricity." D. F. Sinclair. Dated January 3rd.

124. "Supporting electric accumulators for electric traction purposes and the like." K. Bowen. Dated January 3rd.

125. "Speed regulating switch for electric traction." K. Bowen. Dated January 3rd. (*Complete.*)

143. "Improvements in electric arc lamps." W. J. Davy and G. T. Davies. Dated January 3rd.

148. "An improved electric terminal." L. Ridout. Dated January 3rd.

156. "Improvements in the method of fixing and suspending bare electric conductors." A. B. Blackburn and N. H. White. Dated January 3rd.

166. "Improvements in dynamo-electric machines." C. B. Crawshaw and C. W. Hill. Dated January 4th.

189. "An improved wire cable coupling device for car or trolley cables and the like." A. Kaiser. Dated January 4th. (*Complete.*)

192. "Support for electric lamps or other fixtures." S. S. Bromhead. (O C. White, United States.) Dated January 4th. (*Complete.*)

235. "Improvements in or relating to dynamo-electric machines." R. Belfield. (Westinghouse Electric and Manufacturing Company, United States.) Dated January 4th.

242. "Improvements in, applicable to, or connected with targets, mantles, and the like." F. Richard and T. Leutz. Dated January 4th. (*Complete.*)

305. "Device for preventing the displacement of the roller receiving the current from the cables of electric railways with overhead conductors." P. Meyersfield. Dated January 5th. (*Complete.*)

331. "Improvements in preventing sparking when making and breaking electric circuits." A. Muller and H. Tudor. Dated January 5th.

358. "A new process for the preparation of electric paste accumulators." E. Kosel and F. Frentzel. Dated January 6th.

373. "Improvements in insulated and protected conductors for the transmission of electrical currents." G. Wilkinson. Dated January 6th.

398. "An improved electrically-propelled bicycle." S. Prem. Dated January 6th.

435. "Improvements in and connected with primary batteries." S. W. Maquay. Dated January 6th.

462. "Improvements in, or connected with, electric mains." G. H. Nisbett. Dated January 7th.

468. "Improvements relating to enclosed motors or dynamos." P. Rosling and H. W. Applesby. Dated January 7th.

494. "Automatic rheostat for use in starting electromotors." A. Emrich. Dated January 7th. (*Complete.*)

525. "Improvements in electric signalling." S. P. Thompson. Dated January 7th.

533. "Improvements in electric arc lamps." A. J. Hills. Dated January 8th.

571. "Improved means for making electrical connections upon railway trains." W. Brierley and R. Foster. Dated January 8th.

584. "Improvements in underground conduits for electrical conductors." E. Stanley. Dated January 8th.

586. "Improvements relating to the mounting of dynamo-electric machines." P. R. Jackson & Co., Ltd. and J. S. Lewis. Dated January 8th.

591. "Improvements in telephone transmitters." A. Graham. Dated January 8th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., *price, post free*, 9*d.* (*in stamps*).]

1896.

18,319. "A new or improved electric hand lamp for general or special purposes." A. J. Westmancott. Dated August 19th, 1896. Relates to a portable incandescent electric lamp more particularly for use as a cycle lamp or a policeman's bullseye. The shell is fitted with partitions which leaves a space at the back for an accumulator, and a front space for a lamp which is suspended by its leads. The terminals of the accumulator rest in socket blocks mounted on an ebonite slide. From one of the blocks a connection leads to the switch and thence through the lamp to the other block. The switch is also mounted on an ebonite slide.

18,364. "An improved electric motor or dynamo-electric machine." J. T. Knowles. (J. H. de Thierry, Italy). Dated August 19th, 1896. An electric motor for use in the propulsion of tramways, vehicles, &c., and capable of being employed also as a generator is composed of two independent armatures having their axes of rotation parallel and a single field-magnet the winding of which is arranged symmetrically with the armatures and in planes parallel to their axes. The magnetic circuit is completed by a ring and a single or double pole-piece.

18,485. "Improvements in acid-proof electrical non-conducting articles and composition therefor." W. Morison. Dated August 20th, 1896. A plastic substance, which is both an acid-proof and electric insulating composition suitable for making cases for galvanic batteries and for other purposes, consists of asphalt or of a mixture of asphalt and pitch, which is melted, and a little gutta-percha may be added thereto and while still hot asbestos is thoroughly mixed with it. The mass is spread on a hot surface and worked, beat, and pounded, and during this process a little sulphur may be worked into it. The article required is made by moulding this composition.